

HERPETOLOGY ON THE FRINGES OF THE SUNDA SHELF: A DISCUSSION OF DISCOVERY, TAXONOMY, AND BIOGEOGRAPHY

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ABSTRACT

Updated information on the herpetofaunal composition of the borderlands (upland systems and archipelagos) fringing the Sunda Shelf is presented for Vietnam, Cambodia, and Peninsular Malaysia. It is suggested that the herpetofaunal composition of this region has been shaped by climatic fluctuations throughout Southeast Asia and episodic marine transgressions of the South China Sea, specifically in the region of the Sunda Shelf, resulting in significant degrees of endemism in montane areas and archipelagos. These preliminary findings highlight the understudied nature of these borderlands, especially in Peninsular Thailand and Borneo. Even in the regions discussed, several islands and mountain ranges remain unexplored. As fieldwork progresses into these areas and additional species records are documented, and new lineages discovered and described, it is believed that an awareness of the unappreciated importance of these borderlands to the overall biodiversity and biogeography of Southeast Asia will emerge.

Key words: Southeast Asia, Sunda Shelf, Cambodia, Vietnam, Malaysia, archipelago, herpetology.

INTRODUCTION

The Sunda Shelf is a broad, continental, subaerial extension of Southeast Asia lying beneath the South China Sea that unites the Indochinese Peninsula with the Sundaic regions of Borneo, Java, Sumatra, and the Malay Peninsula (Fig. 1). Its complex tectonic (Hall 1998, 2001, 2002) and climatic history (Woodruff 2003, Bird *et al.* 2005, Outlaw & Voelker 2008, Reddy 2008), coupled with cyclical changes in sea levels over last 5 million years (e.g. Outlaw & Voelker 2008), has contributed to the formation of several archipelagos and mountain systems that now frame the northern, western, and southern fringes of the South China Sea. Since the most recent glacial maximum 18–21 000 years before present (kybp), the Sunda Shelf has gone from being

a fully exposed flood plain supporting a mixture of wet evergreen forests, dry deciduous forests, woodland savannahs, and marshlands crisscrossed by a network of rivers and lakes (Sterling *et al.* 2006), to being completely submerged (Sathiamurthy & Voris 2006). This wholesale transformation has happened multiple times over at least the last five million years but has increased in extent and intensity during more recent times (Bird *et al.* 2005, Sterling *et al.* 2006, Grismer & Grismer 2010). This has had a dramatic effect on the biogeography of many species of Southeast Asia in providing numerous opportunities for range expansions and contractions, extinctions, and secondary contact between sister lineages (e.g. Reddy 2008, Matsui *et al.* 2009). For example at 13 kybp, sea levels were approximately 75 m lower than they are today, still leaving large, marshy, partially exposed, land-positive connections between Indochina

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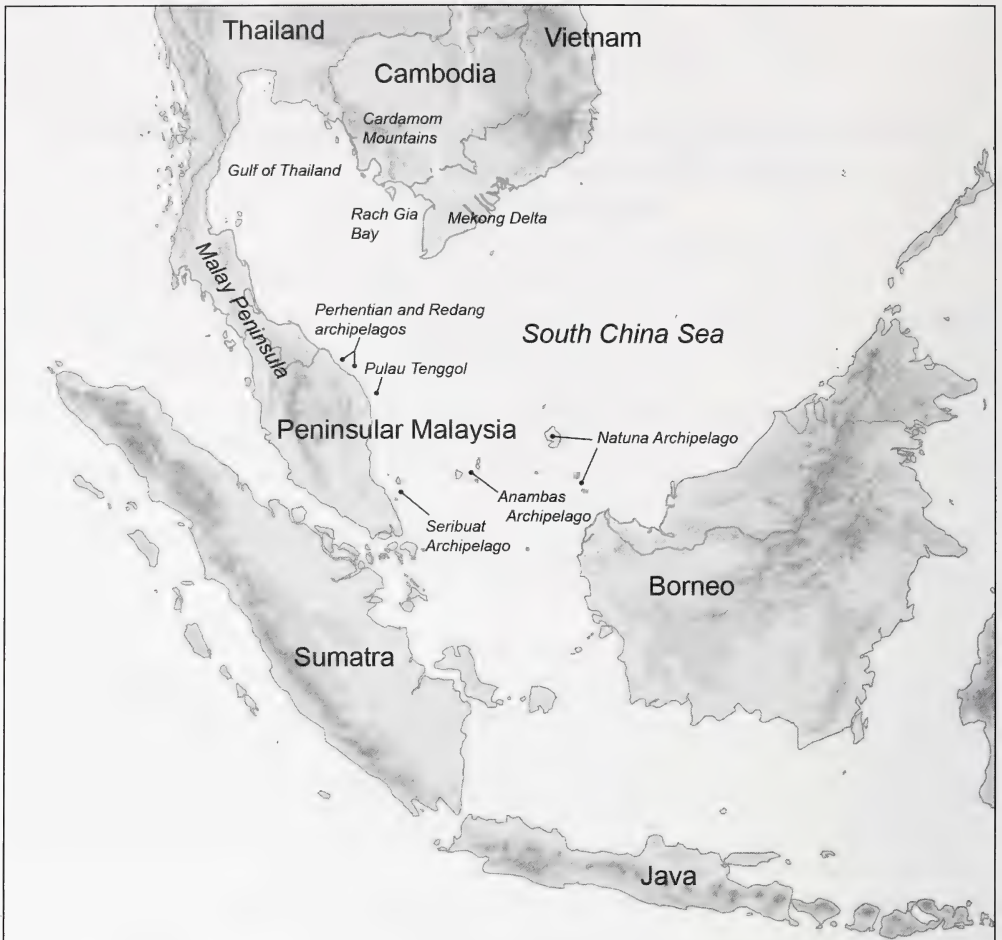


FIG. 1. The Greater Sunda Islands (Borneo, Sumatra, and Java), the borderlands of the Sunda Shelf framing the South China Sea and the Gulf of Thailand, and the archipelagos discussed.

and the Greater Sundas Islands (Sathiamurthy & Voris 2006, Sterling *et al.* 2006). The rapid obliteration of these landbridges due to rising sea levels beginning at 11 kbp, left disjunct populations to evolve in isolation on opposing shores of the newly emerging South China Sea (Grismer & Grismer 2010) as well as isolating several other lineages on the archipelagos currently fringing this area (see below). The warmer and drier climate associated with an expanding sea forced other, more temperate species to retreat upslope with retreating, cool-adapted forests to upland regions (Huges *et al.* 2003, Sterling *et al.* 2006, Outlaw & Voelker 2008, Reddy 2008). The impact on the herpetofauna of such an intricate environmental history manifests itself in high degrees

of endemism in upland systems (e.g. Flower 1896, 1899; Boulenger 1900a,b, 1903, 1908; Laidlaw 1900, 1901a,b; Smith 1922a, 1935; Smedley 1931c, Grandison 1972, Sly 1976, Dring 1979, Hallerman & McGuire 2001; Lim *et al.* 2002; Das *et al.* 2004; Sanders *et al.* 2004; Vogel *et al.* 2004; Grismer 2011b; Grismer *et al.* 2006b, 2007a,b, 2008a,b,c, 2009a,b,c; Matsui & Ibrahim 2006; Grismer 2007a,b, 2008a,b,c; McLeod & Norhyati 2007; Chan-ard *et al.* 2008; Wood *et al.* 2008a, 2009; Chan *et al.* 2009; Matsui *et al.* 2009) and insular (e.g., Smith 1922b; Ouboter 1986; Darevsky & Szczerbak 1997; Das & Lim 2000; Das & Grismer 2003; Grismer 2011a; Grismer *et al.* 2003, 2004b, 2006c, 2009c, 2010a,b; J. Grismer *et al.* 2003; Leong *et al.*

2003; Diaz *et al.* 2004; Leong & Grismer 2004, Grismer 2005, 2006a,b, 2011b; Grismer & Das 2006; Youmans & Grismer 2006; Grismer & Ngo 2007; Grismer & Chan 2008; Ngo *et al.* 2008; Chan & Norhayati 2010), fragmented distribution patterns, and sister group relationships across marine and terrestrial biogeographic barriers (Inger & Voris 2001, de Bruyn *et al.* 2005, Outlaw & Voelker 2008, Reddy 2008, Grismer & Grismer 2011, Grismer *et al.* 2010c and in press). In general, these biogeographical patterns are more easily observed in the herpetofauna of these regions because they are not usually erased by long-distance dispersal (e.g., Outlaw & Voelker 2008) and remain embedded in the phylogenetic structure and the geographical distribution of this relatively sedentary fauna. Such patterns are just now beginning to emerge as more researchers are beginning to analyze the evolutionary relationships and phylogeographic structure of wide-ranging Indo-Malayan lineages (e.g., Karns *et al.* 2000; Inger & Voris 2001; Evans *et al.* 2003; Matsui *et al.* 2005a, 2010a; Grismer *et al.* in press) as well as publishing the results of explorative field work in some of the

more inaccessible continental regions and archipelagos along these borderlands (e.g., Grismer & Ngo 2007; Grismer *et al.* 2007a,b, 2008a,b,d; Ngo 2008; Ngo *et al.* 2008; Stuart & Emmet 2006; Stuart *et al.* 2006) that is foundational to the biogeographical analyses. Reported here are new data from explorations of the coastal and insular regions of southern Vietnam, Cambodia, and the Malay Peninsula that will be incorporated into a growing database detailing the biogeographic history of the Indo-Malayan herpetofauna.

SOUTHERN VIETNAM: MEKONG DELTA REGION AND THE ISLANDS OF RACH GIA BAY

The mountainous, continental border framing much of the northern edge of the Gulf of Thailand extends from the Yai and Soi Dao Tai mountains of eastern Thailand through the Cardamom Mountains of southwestern Cambodia, eastward to the Bay Nui Mountains of southwestern Cambodia, eastward to the Bay Nui Mountains of the Mekong Delta region of southern Vietnam (Figs. 1, 2). Associated with these larger



FIG. 2. The habitat islands of the southern Mekong Delta and the islands of Rach Gia Bay, Vietnam for which herpetofaunal records exist.

ranges are numerous isolated granite and karst uplifts that punctuate the Mekong Delta region, particularly in southern Vietnam (Fig. 2). These borderlands also include numerous offshore islands lying within the 10-m depth contour extending from Ko Chang Island, Thailand to Phu Quoc Island, Vietnam and many of the smaller islands in Rach Gia Bay off the south coast of southern Vietnam (Figs. 1, 2). During the mid-Holocene sea level highstand 4.2 - 7 kypb (Nguyen *et al.* 2000, Sathiamurthy & Voris 2006), the uplifted areas along the coastline and farther inland existed as islands (Sterling *et al.* 2006), effectively limiting gene flow between populations inhabiting them (Grismer & Ngo 2007). During the short time interval following the ocean's regression to its current level, the Mekong River changed course for the last time, turning to the east and no longer draining directly into the Tonle Sap Basin of Cambodia. This diverted massive amounts of deltaic deposits and rapidly formed the current Mekong Delta of southeastern Cambodia and southern Vietnam, fanning eastward from Phnom Penh, Cambodia to the mouth of the Saigon River in the north, and southward to form the entire Ca Mau Peninsula of Vietnam (Attwood & Johnston 2001, Ta *et al.* 2002). What exists today is an extensive alluvial fan (on which little in the way of natural vegetation remains) punctuated by numerous karst and granite habitat islands. The discovery of new species on these small, isolated, rocky habitat islands such as Nui Cam Hill, Tuc Dup Hill, and Hon Dat Hill (Grismer & Ngo 2007, Ngo 2008; Fig. 2), underscores the archipelago-like nature of the southern Mekong Delta region that is mirrored by the growing degree of insular endemism on the small islands off the adjacent coast in Rach Gia Bay (Darevsky & Szczerbak 1997; Grismer & Ngo 2007; Ngo *et al.* 2008; Grismer *et al.* 2008e, 2010a). To date, four endemic species of lizards are known from the habitat islands in the southern delta region (Grismer & Ngo 2007, Ngo 2008) and there still remains many more "islands" in need of exploration. Much the same situation exists with the 90+ islands of Rach Gia Bay (Fig. 2) from which herpetological records are known from only seven (Darevsky & Szczerbak 1997; Darevsky 1999; Grismer & Ngo 2007; Grismer *et al.* 2008e, 2010a; Ngo *et al.* 2008), and from which six endemic species have been reported and several more are in the process of being described (Grismer *et al.* in press, Ngo *et al.* in press). Therefore it is essential to present up-to-date baseline data on the herpetofauna of these

islands in order to provide a foundation from which other work may continue.

There are approximately 92 islands within Rach Gia Bay. Many of these occur in close proximity forming archipelagos such as those associated with Phu Quoc Island, Tien Hai Island, Son Hai Island, and Nam Du Island (Fig. 2) whereas others such as Tho Chau, Hon Khoai, Hon Son (=Rai), Hon Tre, and Hon Nghe are generally larger and more isolated (Fig. 2). The islands located near the coast of southern Vietnam, such as the Tien Hai islands and Son Hai islands, tend to have a basement of karst (Fig. 3) whereas the more outlying islands such as Hon Khoai, Hon Tre, Hon Rai, and Phu Quoc have a granite basement (Fig. 4). None of the larger islands except Hon Khoai are covered with primary forest and on most, secondary growth is extensive. Only a few, such as Hon Son, are dominated by viney secondary growth.

Published herpetological records exist for the islands of Phu Quoc (Moler *et al.* 2008), Hon Thom (Darevsky & Szczerbak 1997, Darevsky 1999), Hon Tho Chau (Darevsky 1999), Hon Tre (Grismer & Ngo 2007, Ngo 2008), Hon Son (Grismer *et al.* 2008e), and Hon Khoai (Grismer *et al.* 2010a). To this we add 54 new records for five more islands and 27 new records for islands whose herpetofaunas have already been reported. All new, confirmed records were observed firsthand, collected, and/or photographed by NVT, LLG, and/or JLG.

PHU QUOC ISLAND

Phu Quoc Island is by far the largest (c. 675 km²) and most environmentally diverse island in Rach Gia Bay. It, and the numerous small islands extending from its narrow, southern terminus, form the western edge of Rach Gia Bay and represent emergent offshore fragments of the Bokor Plateau of the Cardamom Mountains of Cambodia (Fig. 2). Moler *et al.* (2008) reported 54 species of amphibians and reptiles from Phu Quoc Island (Table 1) to which we add one frog *Microhyla pulchra* (LSUDPC 2900), one skink *Sphenomorphus maculatus* (LSUDPC 1255), and four colubrid snakes *Dryocalamus davidsoni* (LSUDPC 3083–85), *Lycodon laoensis* (LSUDPC 2995), *Oligodon barroni* (LSUDPC 3192–94), and *Xenochrophis trianguligerus* (LSUDPC 5303). All were observed during the evening along a rocky stream at Phu Quoc National Park (10°17.452'N, 104°02.380'E) during 24–26 July 2007. To this we also tentatively add the turtle *Cyclemys pulchtristriata*.



FIG. 3. A small karst island in the Son Hai Archipelago, Vietnam.



FIG. 4. The granite-based island of Hon Khoai, Vietnam.

TABLE 1. Hereptological records from islands of the Phu Quoc Archipelago.

	Phu Quoc	Hon Thom		Phu Quoc	Hon Thom
Amphibia			<i>Gehyra mutilata</i>	x	x
Anura			<i>Gekko gecko</i>	x	x
Bufonidae			<i>Ptychozoon lionotum</i>	x	
<i>Duttaphrynus melanostictus</i>	x		Lacertidae		
Ranidae			<i>Takydromus sexlineatus</i>	x	
<i>Limnonectes kuhlii</i>	x		Sicncidae		
<i>Occidozygus laevis</i>	x		<i>Dasia olivacea</i>	x	
<i>Hylarana macrodactyla</i>	x		<i>Lipinia vittigera</i>	x	
<i>Hylarana taipehensis</i>	x		<i>Lygosoma bowringii</i>	x	
<i>Hylarana nigrovittata</i>	x		<i>Eutropis macularia</i>	x	x
Microhylidae			<i>Eutropis multifasciata</i>	x	x
<i>Kalophrynus interlineatus</i>	x		<i>Sphenomorphus maculatus</i>	x	x
<i>Kaloula pulchra</i>	x		Varanidae		
<i>Microhyla heymonsi</i>	x		<i>Varanus salvator</i>	x	x
<i>Microhyla pulchra</i>	x		Squamata—Snakes		
<i>Micryletta inornata</i>	x		Cylindropidae		
<i>Chirixalus nongkhorensis</i>	x		<i>Cylindrophis rufus</i>	x	
<i>Polypedates leucomystax</i>	x		Pythonidae		
<i>Theloderma stellatum</i>	x		<i>Broghammerus reticulatus</i>	x	
Cacaelia			Colubridae		
<i>Ichthyophis bananicus</i>	x		<i>Ahaetulla prasina</i>	x	
Reptilia			<i>Boiga cyanea</i>	x	
Chelonia			<i>Chrysopelea ornata</i>		x
Bataguridae			<i>Dryocalamus davidsoni</i>	x	
<i>Cyclemys pulchrestriata</i>	x		<i>Enhydryis bocourti</i>	x	
Trionychidae			<i>Enhydryis enhydryis</i>	x	
<i>Amayda cartilaginea</i>	x		<i>Enhydryis plumbea</i>	x	
Squamata—Lizards			<i>Homolopsis buccata</i>	x	
Agamidae			<i>Lycodon laoensis</i>	x	
<i>Acanthosaura cardamomensis</i>	x		<i>Oligodon barroni</i>	x	
<i>Calotes versicolor</i>	x		<i>Oligodon ocellatus</i>	x	
<i>Draco indochinensis</i>	x		<i>Pareas carinatus</i>	x	
<i>Draco maculatus</i>	x		<i>Psammodynastes pulverulentus</i>	x	
<i>Physignathus cocincinus</i>	x		<i>Pyas korros</i>	x	
Leiolepididae			<i>Xenochrophis piscator</i>	x	
<i>Leiolepis reevesii</i>	x		<i>Xenochrophis triangulageris</i>	x	
Gekkonidae			Elapidae		
<i>Cyrtodactylus paradoxus</i>		x	<i>Bungarus candidus</i>	x	
<i>Cyrtodactylus phuquocensis</i>	x		<i>Calliophis maculiceps</i>	x	
<i>Dixonius siamensis</i>	x		<i>Naja siamensis</i>	x	
<i>Hemidactylus frenatus</i>	x	x	Viperidae		
<i>Hemidactylus bowringii</i>		x	<i>Cryptelytrops albolabris</i>	x	
<i>Hemidactylus platyurus</i>		x	<i>Cryptelytrops cf. cardamomensis</i>	x	

This specimen is based on a partial left posterior plastron. According to Peter Paul van Dijk (*in litt.* 2009), the radiating pattern of each scute restricts it to *Heosemys* or *Cyclemys*. The forward curvature of the anal scute as it goes from the edge of the plastron to the midline is characteristic of *Cyclemys*. *Cyclemys pulchrisriata* is the commonest species of *Cyclemys* in this region.

HON THOM ISLAND

Hon Thom is a small island (17 km²) lying 8 km off the southern tip of Phu Quoc Island, Kien Giang Province (9°57.22'N, 104°01.030'E; Fig. 2). Hon Thom is steep-sided and rocky, reaching 162 m in elevation. Most of the vegetation is secondary deciduous forest scattered among volcanic rock outcroppings, and in the flat coastal areas the forest has been completely cleared and replanted with mangos, jackfruit, and logan. Darevsky (1999) reported nine species of lizards and one species of snake (Table 1). To Darevsky's (1999) list we add *Varanus salvator* which were seen during April 2006 foraging in the estuaries as well as along the forest trails, and *Python reticulatus* which was found raiding a chicken house in the village (Table 1). Identifications were confirmed by the use of Nguyen *et al.* (2009).

HON NGHE ISLAND

Hon Nghe is a small island (25 km²) lying 14 km off the coast of Chua Hang, Kien Giang Province (10°01.405'N, 104°33.151'E; Fig. 2). Hon Nghe is steep-sided and reaches 338 m in elevation. Much of

its forest has been cleared and replanted with mango groves and other fruit trees. Remaining patches of secondary forest occur on the slopes toward the interior of the island and a small outcropping of karst occurs in the island's northeastern section. We report here the first herpetological records for this island, obtained on 19 May 2007 (Table 2). Identifications were confirmed by the use of Nguyen *et al.* (2009). Unfortunately, the voucher photographs were irretrievably lost during a hard-drive crash. Thus these records must remain unconfirmed. Species found were the frogs *Duttaphrynus melanostictus* and *Polypedates* cf. *leucomystax*, the lizards *Calotes versicolor*, *Hemidactylus frenatus*, *H. platyurus*, *Gekko gecko*, and *Varanus salvator*, and the snakes *Broghamerus reticulatus* and *Chrysopelea ornata*. The majority of these species were found in disturbed areas of the plantations and in and amongst human habitations.

HON TRE ISLAND

Hon Tre is a small island (27 km²) lying 15 km off the coast of Rach Gia City (9°58.342'N, 104°50.955'E; Fig. 2). It is steep-sided, reaching 315 m in elevation and is dominated by secondary and primary semi-deciduous forest that covers a landscape composed of nearly continuous outcrops of large granite boulders. *Cnemaspis caudanivea* and *Cyrtodactylus eisenmani* are the only species to have been reported from Hon Tre Island (Grismer & Ngo 2007, Ngo 2008) and to those reports we add the frog *Rana taipensis* (LSUDPC 3106) and the lizards *Calotes versicolor* (LSUDCP 2949), *Draco maculatus* (LSUDCP

TABLE 2. Herpetofauna of Hon Nghe, Hon Tre, Hon Son Rai (=Hon Son), Hon Chuoi, Hon Sao, Hon Khoai, Nam Du, and Tho Chau islands.

	Hon Nghe	Hon Tre	Hon Son	Hon Khoai	Hon Sao	Hon Chuai	Tho Chau	Nam Du
Amphibia								
Anura								
<i>Hylarana taipensis</i>		x						
<i>Hylarana erythraea</i>			x					
Bufonidae								
<i>Duttaphrynus melanostictus</i>	x	x	x			x	x	x
Rhacophoridae								
<i>Polypedates</i> cf. <i>leucomystax</i>	x	x	x	x	x	x	x	x
<i>Ichthyophis</i> sp.			x					

TABLE 2. Continued.

	Hon Nghe	Hon Tre	Hon Son	Hon Khoai	Hon Sao	Hon Chuoï	Tho Chau	Nam Du
Reptilia								
Squamata – Lizards								
Agamidae								
<i>Calotes versicolor</i>	x	x	x		x	x		x
<i>Draco maculatus</i>		x	x	x		x		
Gekkonidae								
<i>Cnemaspis caudanivea</i>		x						
<i>Cnemaspis psychedelica</i>				x				
<i>Cyrtodactylus hontreensis</i>		x						
<i>Cyrtodactylus eisenmani</i>			x					
<i>Cyrtodactylus paradoxus</i>								x
<i>Cyrtodactylus</i> sp.1				x	x	x		
<i>Cyrtodactylus</i> sp.2		x						
<i>Cyrtodactylus</i> sp.3				x				
<i>Cyrtodactylus</i> sp.4							x	
<i>Hemidactylus bowringi</i>							x	
<i>Hemidactylus frenatus</i>	x	x	x	x	x	x	x	x
<i>Hemidactylus platyurus</i>	x	x	x	x	x	x	x	
<i>Gehyra mutilata</i>		x		x			x	
<i>Gekko gecko</i>	x	x	x	x	x	x	x	x
<i>Lepidodactylus lugubris</i>							x	
<i>Ptychozoon trinitaterra</i>		x						
Sicncidae								
<i>Dasia olivacea</i>				x		x	x	
<i>Eutropis longicaudata</i>		x						
<i>Eutropis multifasciata</i>						x	x	
Varanidae								
<i>Varanus nebulosus</i>							x	
<i>Varanus salvator</i>	x	x	x	x	x	x		x
Squamata – Snakes								
Typhlopidae								
<i>Ramphotyphlops braminus</i>		x	x					
Pythonidae								
<i>Broghammerus reticulatus</i>	x	x	x	x	x	x	x	
Colubridae								
<i>Ahaetulla prasina</i>		x		x				
<i>Chrysopelea ornata</i>	x			x				
<i>Coelognathus radiatus</i>							x	
<i>Boiga cyanea</i>		x						
<i>Oligodon</i> sp.			x					
<i>Lycodon capucinus</i>			x	x				x
Viperidae								
<i>Cryptelytropis honsonensis</i>			x					
<i>Cryptelytropis albolabris</i>		x						x

3081), *Gehyra mutilata* (LSUDCP 4086), *Gekko gecko* (LSUDCP 3086), *Hemidactylus fernatus* (LSUDCP 3179), *H. platyurus* (LSUDCP 3089), *Ptychozoon trinitaterra* (unconfirmed), *Eutropis longicaudata* (LSUDCP 3495), and *Varanus salvator* (LSUDPC 5244), and the snakes *Ramphotyphlops braminus* (unconfirmed), *Broghammerus reticulatus* (LSUDPC 0197), *Boiga cyanea* (unconfirmed), *Ahaetulla prasina* (LSUDCP 3033), and *Cryptotyrops albolabris* (LSUDPC 3050) (Table 2). All were collected during 27–28 July 2007. *Calotes versicolor* were seen sleeping in vegetation. The *Draco maculatus* was seen 3 m up on the trunk of a large ornamental tree along the coast. The *Hemidactylus*, *Gehyra*, and *Gekko* were common at night on buildings and the *Ramphotyphlops braminus* was found beneath a small rock along the edge of a path in soft soil but escaped from the bag shortly after capture. The *Ahaetulla prasina* was found during the day in disturbed forest crawling through vegetation.

HON SON (=RAI) ISLAND

Hon Rai Island is located 61.2 km southeast of Rach Gia City (9°47.95'N, 104°37.86'E; Fig. 2). This very small island (c. 22 km²) reaches 405 m in elevation and is composed of large granite boulders that extend from the shoreline to its peaks with little to no primary vegetation remaining. Walking trails across the island have been cut through the highly degraded secondary vegetation that is heavily overrun with large tracts of bamboo and vines. The walking trails cross large expanses of boulder outcrops forming cavities extending as much as 20 m below the surface of the ground. Grismer *et al.* (2008e) reported 10 species of amphibians and reptiles from Hon Rai Island (Table 2) to which we add the frog *Rana erythraea* (heard calling), the caecilian *Ichthyophis* sp. (specimen lost), the lizard *Varanus salvator* (observed along the beach), and the snakes *Oligodon* sp.1 (LSUDPC 5304–11), *Oligodon* sp.2 (LSUDPC 5312–16), and *Lycodon capucinus* (LSUDPC 3242). The report of *Draco sumatranus* (Grismer *et al.* 2008e) is corrected here to *D. maculatus* (LSUDCP 3082), their *Cyrtodactylus* sp.1 has now been described as *C. honsonensis* (Ngo *et al.* 2008), and their *Cyrtodactylus* sp.2 is in the process of being described.

HON CHUOI

Hon Chuoi is a small island (18 km²) lying 35 km off the east coast of the Ca Mau Peninsula

(8°57.031'N, 104°31.315'E; Fig. 2) that reaches 120 m in elevation. Hon Chuoi is covered by secondary evergreen forest on its slopes while the flat, low-lying periphery of the island is composed of coconut, mango, and other planted groves. We report here the first herpetological records for this island, obtained on 24 February 2009 (Table 2). Identifications were confirmed by the use of Nguyen *et al.* (2009). Unfortunately, the voucher photographs were irretrievably lost during a hard-drive crash. Thus these records must remain unconfirmed. Species reported are the frogs *Duttaphrynus melanostictus* and *Polypedates* cf. *leucomystax*, the lizards *Calotes versicolor*, *Draco maculatus*, *Cyrtodactylus* sp.1, *Hemidactylus frenatus*, *H. platyurus*, *Gekko gecko*, *Dasia olivacea*, *Eutropis multifasciata*, and *Varanus salvator*, and the snake *Broghammerus reticulatus*. All species were found in secondary growth along the coast.

HON KHOAI ISLAND

Hon Khoai is a small (8 km²) island lying 18 km off the southern tip of the Ca Mau Peninsula and is the easternmost island in Rach Gia Bay (Fig. 2). The island reaches 228 m in elevation and is generally steep-sided with a granite basement from which several large boulder crops originate beneath a canopy of primary semi-deciduous forest (Fig. 4). Grismer *et al.* (2010a) made a brief reconnaissance of the northwestern side of the island among an outcrop of granite boulders at approximately 150 m elevation on the island's slope on 24–25 July 2009 and documented the presence of the frog *Polypedates* cf. *leucomystax*, the lizards *Draco maculatus*, *Cnemaspis psychedelica*, *Cyrtodactylus* sp.1, *Hemidactylus frenatus*, *H. platyurus*, *Gehyra mutilata*, *Gekko gecko*, *Dasia olivacea*, and *Varanus salvator*, and the snakes *Broghammerus reticulatus*, *Ahaetulla prasina*, *Lycodon capucinus*, and *Chrysopelea ornata* (Table 2).

HON SAO ISLAND

Hon Sao is a small, satellite island (2 km²) lying 1 km off the southeast coast of Hon Khoai Island (8°57.032'N, 104°51.064'E; Fig. 2) and reaches 164 m in elevation. Its geology and forest cover is much like that of Hon Khoai. We report here the first herpetological records for this island, obtained on 3 April 2009 (Table 2). Identifications were confirmed by the use of Nguyen *et al.* (2009). Unfortunately, the voucher photographs were irretrievably lost during a hard-drive crash, so these records must

remain unconfirmed. Species reported are the frog *Polypedates* cf. *leucomystax*, the lizards *Calotes versicolor*, *Cyrtodactylus* sp.1, *Hemidactylus frenatus*, *Hemidactylus platyurus*, *Gekko gekko*, *Varanus salvator*, and the snake *Brogghammerus reticulatus*. Surprisingly, *Cnemaspis psychedelica*, a species endemic and very common on granite boulders on Hon Khoai (Grismer *et al.* 2010a), was not found on Hon Sao.

NAM DU ARCHIPELAGO

The Nam Du Archipelago is a cluster of 17 small islands lying 84 km southwest of Rach Gia City (Fig. 2). The largest island of this group, Nam Du, is elongate in shape, reaches 310 m in elevation, and is dominated by low, secondary, semi-deciduous scrub on a sandstone basement. We surveyed this island on 28–29 June 2009 and present here the results of that survey, representing the first herpetological records for the island (Table 2). *Duttaphrynus melanostictus* (LSUDPC 5048) and *Polypedates* cf. *leucomystax* (LSUDPC 5115) were common at night along the sides of the road near the villages. Several juvenile *Calotes versicolor* (LSUDPC 5051) were seen sleeping in disturbed vegetation along trails and along the sides of roads. *Cyrtodactylus paradoxus* (LSUDPC 5074–76) was found foraging along the rocky areas of coastal bluffs and along rocks within the intertidal zone as well as inland in rocky areas in the forest. *Hemidactylus frenatus* (LSUDPC 5092) and *H. platyurus* (LSUDPC 5094) were common on the walls of buildings in the villages. *Gekko gekko* was heard calling from within houses in the village. A single specimen of *Lycodon capucinus* (LSUDPC 5107) was found foraging among the rocks of the intertidal zone, presumably hunting *C. paradoxus*. *Cryptelytrops albolabris* was reported by locals and remains unconfirmed. *Varanus salvator* was seen foraging in the intertidal area.

HON THO CHAU ISLAND (=CU LAO PANJANG =THO CHU)

Hon Tho Chau Island is the most remote island in Rach Gia bay, located 140 km off the coast from Rach Gia City and is surrounded by seven smaller satellite islands (Fig. 2). Hon Tho Chau Island is 12 km² in size, covered in secondary semi-evergreen forest, and reaches 167 m in elevation. Darevsky (1999) reported nine species of lizards and three species of snakes (Table 2). To this we add the frogs *Duttaphrynus melanostictus*, *Kaloula pulchra*, and

Polypedates cf. *leucomystax*, the lizard *Cyrtodactylus* sp.4 (Ngo *et al.* in press), and the snake *Xenopeltis unicolor*. All records for this island were obtained on 20 July 2008 and 15 July 2009 and their identifications were confirmed by the use of Nguyen *et al.* (2009). Unfortunately, the voucher photographs were irretrievably lost during a hard-drive crash.

Although the islands of Rach Gia Bay form a somewhat environmentally incongruous group, the herpetofauna on them is in generally fairly similar (Tables 1, 2). The majority of the islands surveyed thus far tend to share a similar suite of species that are good overwater dispersers, island colonizers, and human commensals. These include *Duttaphrynus melanostictus*, *Polypedates* cf. *leucomystax*, *Calotes versicolor*, *Draco maculatus*, *Hemidactylus frenatus*, *H. platyurus*, *Gekko gekko*, *Varanus salvator*, and *Brogghammerus reticulatus*. Endemics do occur on some islands and where there is one endemic there are usually others (Table 2). For example, *Cnemaspis psychedelica* on Hon Khoai Island exists with *Cyrtodactylus* sp.1. On Hon Rai Island, *Cyrtodactylus* sp.3, *Cyrtodactylus honsonensis*, and *Cryptelytrops honsonensis* are all endemic. Much the same is true for Hon Tre Island, whose endemics include *Cnemaspis caudanivea*, *Cyrtodactylus eisemanae*, and *Cyrtodactylus* sp.2. The exception is the large island of Phu Quoc, whose only endemic thus far is *Cyrtodactylus phuquocensis* (Ngo *et al.* 2010). The large size of this island and its varied habitats are similar to those of the adjacent continent and thus the strong selection pressures attendant on very small islands with restrictive habitats may not be a factor in driving the differentiation of new lineages.

SOUTHWESTERN CAMBODIA: THE CARDAMOM REGION

Cambodia's location in the southern portion of the Indochinese Peninsula places it at the northern end of the Indo-Malayan Forest (Webb 2005), which makes it a critical biogeographical link between Southeast Asian and East Asian herpetofaunas. Several recent studies have demonstrated that many wide-ranging lineages previously considered to be single species are actually composed of multiple species, and the species boundaries within many of these complexes occur within this general region of Indochina (e.g., Wüster *et al.* 1995; Matsui *et al.* 1996, 2001, 2005a,b, 2010a; Ota *et al.* 2001; Bain *et al.* 2003; Wood *et al.* in press). Therefore, in



FIG. 5. The Cardamom region of southwestern Cambodia.

order to more fully understand the historical biogeography of the Indochinese herpetofauna and to implement effective measures of conservation, groundwork from baseline field surveys and alpha-taxonomic investigations must first be laid. Unfortunately, years of political turmoil and genocide had all but halted any field-based studies in Cambodia, and as such, it lags behind neighboring countries of Indochina, namely Vietnam and Thailand (see Taylor 1962, 1963, 1965; Campden-Main 1969; Deuve 1970; Cox 1991; Manthey Grossmann 1997; Inger *et al.* 1999; Ziegler 2002; Chan-ard 2003; Teynie *et al.* 2004; Stuart 2005; Neang & Holden 2008, and references therein). Only within the last few years has the political situation in Cambodia stabilized enough to enable reasonably safe fieldwork in some areas (e.g., Stuart *et al.* 2006; Stuart & Emmet 2006; Grismer *et al.* 2007a,b, 2008b,d; Bezuijen *et al.* 2009).

Cambodia for the most part is a large floodplain that was formed over the last five million years from shifting drainages of the Mekong River and several of its smaller tributaries (Atwood & Johnston 2001).

Currently, the central basin of Cambodia continues to receive drainage from the Khorat Plateau of north-eastern Thailand to the north and from the Langiban and Kontum Plateaus of Vietnam in the east. Additionally, seasonal incursions from the Mekong River flowing into the Tonle Sap may increase the size of this lake by as much as 300%, causing it to spread out over much of central Cambodia. Bordering the southwestern edge of this central flood basin is the Cardamom region of southwestern Cambodia. This region is dominated by a rugged, physiographically complex system of mountains that frame much of the northern margin of the Gulf of Thailand (Fig. 5). The Cardamom Mountains begin just beyond the Thai Border in the Khao Soi Dao Mountains and extend 225 km to the southeast through the mountains of Kirirom National Park to the Elephant Mountains of Bokor National Park just east of Kampong Son Bay. From here they emerge offshore as the island of Phu Quoc, Vietnam (Fig. 5). Its conspicuous topography is composed of a series of semi-isolated prominent peaks, plateaus, and associated foothills separated by low-lying regions of varying

terrain (Grismer *et al.* 2008b). In Cambodia, the western peaks, Phnom Samkos and Phnom Tumpor, reach 1717 m and 1551 m in elevation, respectively, and maintain regions of disturbed, deciduous dipterocarp forest throughout their intervening areas, and large tracts of lowland and evergreen hill forests along their slopes and upper elevations, respectively (Grismer *et al.* 2008b). The northeastern mountain, Phnom Aural, is the tallest peak in Cambodia, reaching 1813 m, and also maintains significant tracts of deciduous, dipterocarp forests and pristine evergreen forests (Grismer *et al.* 2007a). Between these ranges, the central section of the Cardamom Mountains reaches 1549 m and is dominated by a large plateau of evergreen and pine forests interlaced with a mosaic of grasslands. The Elephant Mountains of Bokor National Park form the continental southeastern portion of the Cardamom Mountains and reach 1087 m in height. The floral composition of this range is greatly affected by continuous, onshore winds arising from the Gulf of Thailand, which promote a mixture of grassland and heath forest (Stuart & Emmet 2006) and shroud the upper elevations of the Bokor Plateau in thick fog for much of the year. The slopes of the Elephant Mountains support tracts of primary evergreen forests and steep, fast-flowing, rocky streams.

A recent uptick in field surveys in the Cardamom region has begun to reveal its extensive herpetofaunal diversity as well as its growing level of endemism (Grismer *et al.* 2007a,b, 2008b,d; Stuart & Emmet 2006). The most recent surveys of the Cardamom Region (Grismer *et al.* 2008b) list 40 species of frogs, one caecilian, 10 turtles, 35 lizards, 51 snakes, and one crocodile, the vast majority of which have been reported from the mountainous areas and the intervening lowlands. Overlooked however, have been the low-lying coastal regions between the Cardamom Mountains and the Gulf of Thailand. Two such regions recently surveyed include Botum Sakor National Park and Ream National Park. These national parks are on coastal prominences that form the northwestern and southeastern borders of Kompong Som Bay (Fig. 5). Although they are isolated politically, they are connected around the northern edge of Kompong Son Bay by continuous habitat. As such, their records are combined in Table 3. Surveys of these regions resulted in the discovery of five additional species previously unknown to the Cardamom Region, including the skink genus *Tropidophorus* and the elapid genus *Calliophis*. Additionally, the distri-

butions of 32 species of amphibians and reptiles were extended to include these coastal regions (Table 3).

BOTUM SAKOR NATIONAL PARK

Botum Sakor National Park is located in Kompong Som Province along the southern coast of Cambodia (Fig. 5). It encompasses 1834 km² and its coastline is fringed by mangrove swamps and beaches. The interior offers some topographical relief with a small uplift running the length of the park and reaching approximately 335 m in elevation, supporting a semi-deciduous forest. Collections here were made intermittently in various habitats between 5 March and 5 September 2004, 24 April and 23 July 2005, and 18 April and 16 August 2006 by several individuals with Frontier Cambodia.

REAM NATIONAL PARK

Ream National Park is located on the southeastern side of a mountainous prominence due east of Sihanoukville in Kampot Province (Fig. 5). It encompasses 210 km² of coastal lands of which nearly one-third are mangrove forests and the rest semi-deciduous forest covering its low mountain ranges. Collections here were made intermittently in various habitats between 10 February and 24 August 2004 and 4 March and 6 July 2005. The species recorded from these areas are listed below.

Kalophrynus interlineatus. – A single specimen collected from Botum Sakor (FMNH 270638) matches the descriptions of this species from Phnom Samkos (Grismer *et al.* 2008b) and the central Cardamom Mountains (Stuart & Emmet 2006).

Micryletta inornata. – Three specimens were collected from Botum Sakor (FMNH 271545–47) which correspond to the description of this species from Bokor National Park (Grismer *et al.* 2008b) and the central Cardamom Mountains (Stuart & Emmet 2006).

Limnonectes cf. *dabanus*. – One adult female collected from Ream (FMNH 270155) is tentatively assigned to *L. dabanus*. As noted by Smith (1922b) and acknowledged by Stuart *et al.* (2006), females and juveniles of the *L. doriae* group are extremely difficult to tell apart. We elect to tentatively assign this species to *L. dabanus* rather than *L. gyldenstolpei*, which is endemic to the Cardamom region, owing the presence of a dark, inverted V-marking on the upper back (Neang & Holden 2008) which is absent in *L. gyldenstolpei*. This represents

TABLE 3. Checklist of the herpetofauna of the Cardamom Region. X = data from Grismer *et al.* (2008b) and Grismer *et al.* (2009); 0 = new data reported herein.

	North- west	Central	North- east	South- east	Coastal
CAECILIANS					
Ichthyopidae					
<i>Ichthyophis</i> sp.	x	x			
FROGS					
Megophryidae					
<i>Leptolalax</i> sp.			x		
<i>Megophrys auralensis</i> Ohler, Swan & Daltry 2002		x	x		
Bufonidae					
<i>Duttaphrynus melanostictus</i> Schneider 1799	x	x	x		
<i>Ingerophrynus macrotis</i> Boulenger 1887	x	x	x		
<i>Ingerophrynus parvus</i> Boulenger 1887	x	x			
Microhylidae					
<i>Calluella guttulata</i> (Blyth 1855)	x	x			
<i>Kalophrynus interlineatus</i> (Blyth 1855)	x	x	x		0
<i>Kaloula pulchra</i> Gray 1831	x	x	x		
<i>Microhyla annamensis</i> Smith 1923	x	x			
<i>Microhyla berdmorei</i> (Blyth 1856)	x	x		x	
<i>Microhyla butleri</i> Boulenger 1900	x	x	x		
<i>Microhyla fissipes</i> (Duméril, Bibron & Duméril 1841)	x	x			
<i>Microhyla heymonsi</i> Vogt 1911	x	x	x	x	
<i>Microhyla pulchra</i> (Hallowell 1861)	x	x	x		
<i>Micryletta inornata</i> (Boulenger 1890)	x	x		x	0
Ranidae					
<i>Fejervarya cancrivora</i> (Gravenhorst 1829)			x		
<i>Fejervarya limnocharis</i> (Gravenhorst 1829)	x	x	x		
<i>Hoplobatrachus chinensis</i> (Osbeck, 1756)	x	x	x		
<i>Limnonectes</i> cf. <i>dabanus</i> (Smith 1922)					0
<i>Limnonectes gyldestolpei</i> (Anderson 1916)	x				
<i>Limnonectes kochangae</i> (Smith 1922)	x	x	x	x	
<i>Occidozyga lima</i> (Gravenhorst 1829)	x	x	x		
<i>Occidozyga martensii</i> Peters 1867	x	x	x		0
<i>Paa fasciculispina</i> (Inger 1970)	x	x	x		
<i>Hylarana erythraea</i> (Schlegel 1837)		x	x	x	0
<i>Hylarana faber</i> Ohler, Swan & Daltry 2002	x	x	x	x	
<i>Hylarana macrodactyla</i> (Günther 1859)		x			
<i>Hylarana milleti</i> Smith 1921	x	x	x		
<i>Hylarana mortenseni</i> Boulenger 1903	x	x	x	x	
<i>Hylarana taiphensis</i> van Denburgh 1909	x	x			
Rhacophoridae					
<i>Chiromantis doriae</i> Boulenger 1893		x			
<i>Chiromantis nongkhorensis</i> (Cochran 1927)	x	x	x	x	
<i>Chiromantis samkosensis</i> Grismer, Neang, Chav, & Holden 2007	x				
<i>Chiromantis vittatus</i> (Cochran 1927)	x	x	x		
<i>Philautus cardamonis</i> Ohler, Swan & Daltry 2002	x				
<i>Philautus parvulus</i> (Boulenger, 1893)	x	x	x	x	

TABLE 3. Continued.

	North- west	Central	North- east	South- east	Coastal
<i>Polypedates</i> cf. <i>leucomystax</i> (Gravenhorst 1829)	x	x	x		
<i>Rhacophorus bipunctatus</i> Ahl 1927	x	x	x		
<i>Rhacophorus bisacculus</i> Taylor 1962	x	x		x	
<i>Theloderma asperum</i> (Boulenger 1886)			x		
<i>Theloderma stellatum</i> Taylor 1962		x			
TURTLES					
Bataguridae					
<i>Batagur baska</i> (Gray 1831 "1830–35")		x			
<i>Cuora amboinensis</i> (Daudin 1802)	x	x	x		
<i>Cyclemys atripons</i> Iverson and McCord 1997	x	x		x	
<i>Heosemys grandis</i> (Gray 1860)		x			
<i>Malayemys subtrijuga</i> (Schlegel & Miller 1844)		x			
<i>Sibenrockiella crassicolis</i> (Gray 1831)		x			
Testudinidae					
<i>Indotestudo elongata</i> (Blyth 1853)		x	x		
<i>Manouria impressa</i> (Günther 1882)	x	x			
Trionychidae					
<i>Amyda cartilaginea</i> (Boddaert 1770)	x	x	x		
<i>Pelochelys cantori</i> Gray 1864		x			
CROCODYLIA					
Crocodylidae					
<i>Crocodylus siamensis</i> (Müller 1838)	x	x			
SQUAMATA (LIZARDS)					
Agamidae					
<i>Acanthosaura cardamomensis</i> Wooid <i>et al.</i> 2009	x	x	x	x	0
<i>Calotes emma</i> Gray 1845	x	x	x		0
<i>Calotes mystaceus</i> Duméril & Bibron 1837	x	x	x	x	
<i>Calotes versicolor</i> (Daudin 1802)	x	x	x	x	0
<i>Draco indochinensis</i> Smith 1928				x	
<i>Draco maculatus</i> (Gray 1845)	x	x	x	x	0
<i>Draco taeniopterus</i> Günther 1861	x	x	x		0
<i>Physignathus cocincinus</i> Cuvier 1829	x	x	x	x	
<i>Pseudocalotes floweri</i> (Boulenger 1912)				x	
Gekkonidae					
<i>Cnemaspis chanthaburiensis</i> Bauer & Das 1996	x				
<i>Cnemaspis neangthyi</i> Grismer, Grismer & Thou 2010	x				
<i>Cyrtodactylus intermedius</i> (Smith 1917)	x	x	x	x	0
<i>Dixonius siamensis</i> (Boulenger 1898)	x	x	x		
<i>Gekko gecko</i> (Linnaeus 1758)	x	x	x		
<i>Gehyra mutilata</i> (Wiegmann 1834)	x		x		
<i>Hemidactylus frenatus</i> Duméril & Bibron 1836	x	x	x	x	
<i>Hemidactylus platyurus</i> (Schneider 1792)	x		x		
<i>Hemiphyllodactylus typus</i> Bleeker 1860					0
<i>Hemiphyllodactylus</i> cf. <i>yunnanensis</i> (Boulenger 1903)	x				
<i>Pychozoon lionotum</i> Annadale 1905		x		x	
Lacertidae					
<i>Takydromus sexlineatus</i> Daudin 1802	x	x			

TABLE 3. Continued.

	North- west	Central	North- east	South- east	Coastal
Scincidae					
<i>Eutropis longicaudata</i> (Hallowell 1857)	x				
<i>Eutropis macularia</i> (Blyth 1853)	x	x	x		
<i>Eutropis multifasciata</i> (Kuhl 1820)	x	x	x		
<i>Lipinia vittigera</i> (Boulenger 1894)	x	x	x	x	
<i>Lygosoma bowringii</i> (Günther 1864)	x	x	x	x	0
<i>Lygosoma quadrupes</i> (Linnaeus 1766)	x				
<i>Scincella melanosticta</i> (Boulenger 1887)	x	x	x	x	0
<i>Scincella rufocaudata</i> (Darevsky & Nguyen 1983)	x	x			
<i>Sphenomorphus indicus</i> (Gray 1853)	x	x	x		
<i>Sphenomorphus maculatus</i> (Blyth 1853)	x	x	x	x	0
<i>Sphenomorphus stellatum</i> (Boulenger 1900)		x			
<i>Tropidoporus microlepis</i> Gunther 1861					0
Leiolepididae					
<i>Leiolepis belliana</i> (Gray 1827)	x		x		
<i>Leiolepis reevesi</i> (Gray 1831)	x		x		
Varanidae					
<i>Varanus nebulosus</i> Gray 1831	x		x		
<i>Varanus salvator</i> Laurenti 1768	x	x	x		
SQUAMATA (SNAKES)					
Typhlopidae					
<i>Ramphotyphlops braminus</i> (Daudin 1803)	x	x			
<i>Typhlops diardii</i> Schlegel 1839	x	x			
<i>Typhlops muelleri</i> Schlegel 1839		x			0
Xenopeltidae					
<i>Xenopeltis concolor</i> Reinwardt in Boie, 1827		x		x	
Pythonidae					
<i>Broghammerus reticulatus</i> Schneider 1801	x				
Colubridae					
<i>Ahaetulla nasuta</i> (Lacépède 1789)	x				
<i>Ahaetulla prasina</i> (Reinwart in Boie 1827)	x	x	x	x	
<i>Amphiesma boulengeri</i> (Gressitt 1937)	x	x	x	x	
<i>Boiga cyanea</i> (Duméril, Bibron & Duméril 1854)	x	x		x	
<i>Boiga dendrophila</i> (Boie 1827)		x		x	
<i>Boiga multomaculata</i> (Boie 1827)			x	x	
<i>Boiga siamensis</i> Nootpand 1971	x	x			
<i>Chrysopelea ornata</i> (Shaw 1802)	x	x	x	x	
<i>Coelognathus flavolineatus</i> (Schlegel 1837)	x				
<i>Coelognathus radiatus</i> (Boie 1827)		x	x	x	
<i>Dendrelaphis pictus</i> Gmelin (1789)	x	x	x		
<i>Dendrelaphis subocularis</i> (Boulenger 1888)			x		
<i>Dryocalamus davisonii</i> (Blanford 1878)	x	x		x	
<i>Dryophiops rubescens</i> (Gray in Gray & Hardwicke 1835)			x		
<i>Enhydriis bocourti</i> (Jan 1865)		x		x	0
<i>Enhydriis plumbea</i> (Boie 1827)	x	x		x	
<i>Gonyosoma oxycephalum</i> (Boie 1827)		x			0
<i>Homalopsis buccata</i> (Linnaeus 1758)	x	x		x	0
<i>Lycodon cardamomensis</i> Daltry & Wüster 2002	x				

TABLE 3. Continued.

	North- west	Central	North- east	South- east	Coastal
<i>Lycodon laoensis</i> Günther 1864	x		x		
<i>Oligodon barroni</i> (Smith 1916)	x				
<i>Oligodon duevei</i> David, Vogel & Van Rooijen 2007	x				
<i>Oligodon fasciolatus</i> (Günther 1864)	x	x			
<i>Oligodon inornatus</i> (Boulenger 1914)	x	x			0
<i>Oreophis porphyraceus</i> (Cantor 1839)	x				
<i>Orthriophis taeniurus</i> (Cope 1861)	x				
<i>Pareas carinatus</i> (Boie, 1828)		x		x	0
<i>Pareas margaritophorus</i> (Jan, 1866)	x	x	x		
<i>Psammodynastes pulverulentus</i> (Boie 1827)	x	x	x	x	
<i>Ptyas korros</i> (Schlegel 1837)	x	x	x		
<i>Ptyas mucosus</i> (Linnaeus 1758)	x				
<i>Rhabdophis chrysargos</i> (Schlegel 1837)	x	x	x		
<i>Rhabdophis nigrocinctus</i> (Blyth 1856)	x	x	x		
<i>Rhabdophis subminiatus</i> (Schlegel 1837)	x	x	x	x	
<i>Sibynophis collaris</i> (Gray 1853)	x				
<i>Sibynophis triangularis</i> Taylor 1965		0			
<i>Xenochrophis flavipunctatus</i> (Hallowell 1860)	x	x	x		0
<i>Xenochrophis trianguligerus</i> (Boie 1827)		x			0
Elapidae					
<i>Bungarus candidus</i> (Linnaeus 1758)	x	x		x	0
<i>Bungarus fasciatus</i> (Schneider 1801)	x	x			
<i>Calliophis maculiceps</i> (Gunther 1858)		0			0
<i>Naja kaouthia</i> Lesson 1831	x				
<i>Naja siamensis</i> Laurenti 1768	x				
<i>Ophiophagus hannah</i> (Cantor 1836)	x				
Viperidae					
<i>Calloselasma rhodostoma</i> (Boie 1827)	x	x	x		0
<i>Cryptelytropis albolabris</i> (Gray 1842)	x	x	x	x	
<i>Cryptelytropis cardamomensis</i> Malhotra, Thorpe & Stuart 2011	x	x	x	x	0
<i>Viridovipera vogeli</i> (David, Vidal & Pauwels 2001)	x	x	x	x	

the first account of this species from the Cardamom region.

Occidozygia martensii. – Three specimens collected at Botum Sakor (FMNH 270625, 270627–28) match the descriptions of this species from the central Cardamom Mountains (Stuart & Emmet 2006) and Phnom Aural (Grismer *et al.* 2007a).

Rana erythraea. – One specimen collected from Botum Sakor (FMNH 270601) corresponds to the description of this species from the central Cardamom Mountains (Stuart & Emmet 2006).

Acanthosaura cardamomensis. – One specimen was collected from Botum Sakor (FMNH 270648) that corresponds to the descriptions of this species

(Wood *et al.* 2010) from the central Cardamom Mountains (Stuart & Emmet 2006) and Phnom Aural (Grismer *et al.* 2007a).

Calotes emma. – Two specimens collected from Botum Sakor (FMNH 270567–68) correspond to the descriptions of this species from the central Cardamom Mountains (Stuart & Emmet 2006).

Calotes versicolor. – One specimen of this species found at Botum Sakor (FMNH 270566) corresponds to the description of this species from the central Cardamom Mountains (Stuart & Emmet 2006), the base of Phnom Aural (Grismer *et al.* 2007a), and eastern Cambodia in Mondolkiri Province (Stuart *et al.* 2006).

Draco maculatus. – One specimen of this species found at Botum Sakor (FMNH 270586) and five specimens from Ream (FMNH 270582–85, 270587) correspond to the diagnoses of this species from central Cardamom Mountains and Bokor National Park (Stuart & Emmet 2006) and the base of Phnom Aural (Grismer *et al.* 2007a).

Draco taeniopterus. – One specimen of this species from Botum Sakor (FMNH 270643) and another specimen from Ream (FMNH 270642) correspond to the diagnoses of this species from central Cardamom Mountains (Stuart & Emmet 2006) and Phnom Aural (Grismer *et al.* 2007a).

Cyrtodactylus intermedius. – One specimen of this species found at Botum Sakor (FMNH 270596) and another at Ream (FMNH 270595) correspond to the diagnoses of this species from central Cardamom Mountains (Stuart & Emmet 2006) and Phnom Aural (Grismer *et al.* 2007a).

Hemiphyllodactylus typus. – One specimen of this species found at Botum Sakor (FMNH 270569) corresponds to the diagnosis of this species from Thailand (Taylor 1963). This is the first record of this species from the Cardamom region.

Lygosoma bowringii. – One specimen of this species found at Botum Sakor (FMNH 270599) matches the diagnosis of this species from central Cardamom Mountains (Stuart & Emmet 2006).

Scincella melanosticta. – One specimen of this species found at Botum Sakor (FMNH 270600) and another specimen from Ream (FMNH 270598) correspond to the diagnoses of this species from the central Cardamom Mountains (Stuart & Emmet 2006) and Phnom Aural (Grismer *et al.* 2007a).

Sphenomorphus maculatus. – Two specimens collected from Ream (FMNH 270644–45) correspond to the descriptions of this species from the central Cardamom Mountains (Stuart & Emmet 2006), and eastern Cambodia in Mondolkiri Province (Stuart *et al.* 2006).

Tropidophorus microlepis. – One specimen found at Botum Sakor (FMNH 270606) corresponds to the description of this species from eastern Cambodia in Mondolkiri Province (Stuart *et al.* 2006). This is the first record of this species and genus from the Cardamom region.

Typhlops muelleri. – Two specimens of this species found at Ream (FMNH 271578–79) correspond to the description of this species from the central Cardamom Mountains (Stuart & Emmet 2006).

Enhydrys bocourti. – One specimen found at Ream (FMNH 271571) corresponds to the description of this species from the central Cardamom Mountains (Stuart & Emmet 2006).

Gonyosoma oxycephalum. – One specimen collected at Ream (FMNH 271571) corresponds to the description of this species from the central Cardamom Mountains (Stuart & Emmet 2006).

Homalopsis buccata. – One specimen of this species found at Botum Sakor (FMNH 271574) corresponds to the descriptions of this species from the central Cardamom Mountains (Stuart & Emmet 2006) and eastern Cambodia in Mondolkiri Province (Stuart *et al.* 2006).

Oligodon cf. *inornatus*. – One specimen of what may be *O. inornatus* was collected at Ream (FMNH 271565). The specimen is a juvenile (SVL ~ 137 mm) with 15 dorsal scale-rows at midbody and a head that has been partially eaten away. According to Saint Girons (1972), *O. inornatus* is the only species of *Oligodon* in Cambodia with 15 dorsal scale-rows. Saint Girons (1972) did not say where on the body the dorsal scale-row counts were made, but they were presumably made at midbody. David *et al.* (2008a) note that *O. ocellatus* and *O. saintgironsi* also have 15 dorsal scale-rows at midbody and David *et al.* (2008b) note that 15 dorsal scale-rows occur just anterior to the vent in *O. taeniatus*, *O. mouboti*, and *O. duevei*. FMNH 271565 can easily be ruled out as belonging to these latter three species owing to the fact that they have dorsal stripes and no sign of bands at any stage of their lives, and have 17 scale-rows at midbody (David *et al.* 2008b). The color pattern of FMNH 271565, however, is not a close match to that of adult *O. inornatus* either, which is reported to be uniform pale brown above and yellowish below (Taylor 1965, Saint Girons 1972). Instead this specimen (in life) was probably light brown dorsally and has 25 thin, whitish, dorsal bands edged in black and bears square black markings on the lateral edges of most of its ventral scales. The dorsal color pattern superficially resembles that of *O. ocellatus* and *O. saintgironsi* in that it is banded, except that there are 13 bands in *O. ocellatus* and 11–14 in *O. saintgironsi* (David *et al.* 2008a). *Oligodon inornatus* may have a color pattern that changes with adulthood. Similar ontogenetic transformations are known from other species, such as *Oligodon fasciolatus* in northern Malaysia (Grismer *et al.* 2006b).

Pareas carinatus. – One specimen of this species from Botum Sakor (FMNH 271564) and another

from Ream (FMNH 271564) correspond to the descriptions of this species from the central Cardamom Mountains (Stuart & Emmet 2006) and eastern Cambodia in Mondolkiri Province (Stuart *et al.* 2006).

Sibynophis triangularis. – A single specimen collected from the central Cardamom Mountains (FMNH 270103) corresponds to the description of material from Mondolkiri Province in eastern Cambodia (Stuart *et al.* 2006). This is the first record of this species from the Cardamom region.

Xenochrophis flavipunctatus. – One specimen collected from Ream (FMNH 271580) corresponds to the description of this species from Thailand (Taylor 1963). It has also been reported from Phnom Tumpor (Daltry & Chheang Dany 2000), the central Cardamom Mountains (Long *et al.* 2002), and Phnom Aural (Swan & Daltry 2002).

Xenochrophis trianguligerus. – One specimen collected from Ream (FMNH 271567) corresponds to the description of this species from the central Cardamom Mountains (Stuart & Emmet 2006).

Bungarus candidus. – One specimen collected from Ream (FMNH 271548) corresponds to the description of this species from Bokor and southern Vietnam (Saint Girons 1972).

Calliophis maculiceps. – One specimen collected from Ream (FMNH 271566) and another from the central Cardamom Mountains at Thma Bang, Koh Kong Province (FMNH 270123) correspond to the description of this species from Cambodia (Saint Girons 1972). These specimens represent the first record of the species and genus from the Cardamom region.

Calloselasma rhodostoma. – One specimen collected from Botum Sakor (FMNH 271577) and another from Ream (271576) correspond to the descriptions of this species from Phnom Aural (Grismer *et al.* 2007a) and the central Cardamom Mountains (Stuart & Emmet 2006).

Cryptelytropis cardamomensis. – One specimen collected from Ream (FMNH 271549) corresponds to the description of this species from the central Cardamoms (Malhotra *et al.* 2011).

These new records indicate that, in general, the herpetofauna of the coastal Cardamom region is a subset of that from various sections of the Cardamom Mountains (Table 3). Nonetheless, the presence of *Hemiphyllodactylus typus* is the first report of this species from Cambodia and *Limnonectes cf. dabanus* and *Tropidophorus microlepis*, which do not occur in

the adjacent Cardamom Mountains, are found in the more northerly regions in Mondolkiri Province (Stuart *et al.* 2006). These reports would indicate that the herpetofauna of this region is still not completely known.

THE MALAY PENINSULA

The Malay Peninsula is one of the world's longest peninsulas, extending roughly 1660 km from Samut Songkhram, Thailand in the north southward to the southern coast of Singapore. Its topography is sculpted by an imbricating, disjunct series of mountain ranges that begin in the highlands of central Indochina and run nearly its entire length (Fig. 6). In the midregion of the Malay Peninsula in southern Thailand, these ranges are separated for 80 km across a rift valley running between the Tenasserim Mountains in the northwest and the Nakhon Si Thammarat Mountains in the southeast (Fig. 6). Another prominent break in this upland system occurs at the southern end of the Sankalakhiri system and runs from Kangar, Perlis in northwestern Peninsular Malaysia, northeastward to Songkhla, Songkhla Province in southern Thailand (Fig. 6). Both these discontinuities have served as historical barriers to dispersal for many groups and as the impetus for vicariant speciation in others (e.g., Huges *et al.* 2003, Woodruff 2003, de Bruyn *et al.* 2005, Outlaw & Voelker 2008, Reddy 2008, Grismer *et al.* in press). South of the Sankalakhiri Mountains, these upland systems trifurcate just north of the Thai-Malaysian border, fan out, and extend southward through Peninsular Malaysia as the expansive and fragmented Banajaran Timur in the east, the Banajaran Bintang in the west, and the longest and centrally positioned Banajaran Titi Wangsa (Fig. 6).

The Malay Peninsula has long been the focal point of herpetological investigations (e.g., Cantor 1847; Flower 1896, 1899; Butler 1902, 1904; Boulenger 1912; Kloss 1915, 1921; Smith 1930; Berry 1975; Tweedie 1983; Denzer & Manthey 1991; Manthey & Grossmann 1997; Chan-ard *et al.* 1999; Lim & Das 1999; Das & Norsham 2003; Grismer 2011b; Grismer & Pan 2008; Wood *et al.* 2008a,b; Grismer *et al.* 2010b,c) and the complex biogeographical nature of its fauna is only beginning to emerge (Inger & Voris 2001; Pauwels *et al.* 2003; Matsui *et al.* 2009; Grismer 2011a,b; Grismer & Grismer 2010; Grismer *et al.* 2010b,c and in press). These biogeographical patterns have been shaped and reshaped numerous times over the last five million years owing to the intermittent, archipelago-like

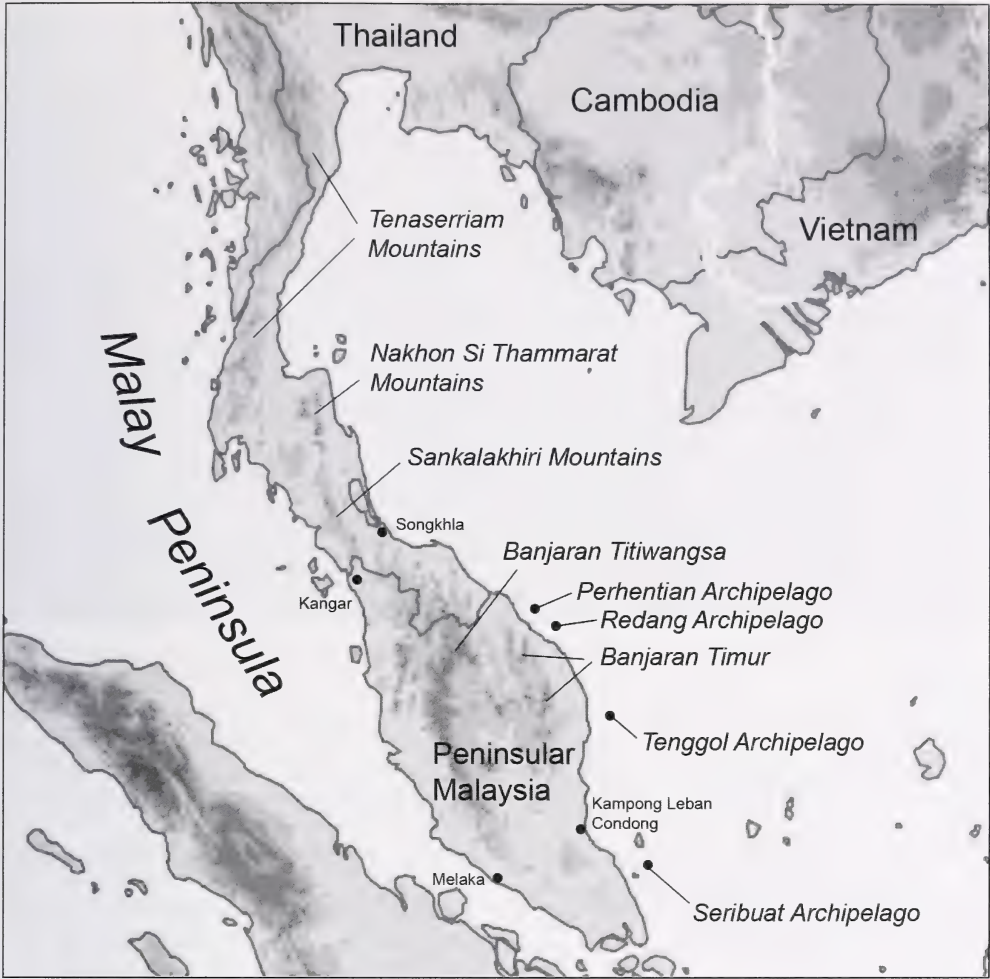


FIG. 6. The Malay Peninsula of southern Thailand and Peninsular Malaysia showing its major mountain ranges and its associated archipelagos for which herpetofaunal records exist.

nature of the Malay Peninsula (Woodruff 2003). Ephemeral seaways cut across the peninsula at the Isthmus of Kra between the Tenasserim and Nakhon Si Thammarat mountains in Thailand and further south between Kangar in northwestern Peninsular Malaysia and Songkhla in southern Thailand, initially multifurcating wide-ranging lineages, while the regression of these same seaways allowed multiple instances of secondary contact and overlap (e.g., Woodruff 2003, Reddy 2008, Grismer *et al.* in press). Such a dynamic geological history manifests itself in tree topology as sister lineages occurring on opposite sides of these vicariant zones in both deep and shal-

low regions of the same phylogeny (Woodruff 2003, L. Grismer *et al.* in press).

Paralleling the mountain systems of the Malay Peninsula, and Peninsular Malaysia in particular, are a series of shallow-water, landbridge archipelagos and islands (Fig. 6) whose geological origins are tied to those of the adjacent peninsular mountains and the emergence and subsidence of the Sunda Shelf. In the South China Sea, the archipelagos of Redang, Perhentian, and Tenggol, as well as several smaller islands and scattered islands in their general vicinity, are relict mountain tops of the Banjaran Timur of Peninsular Malaysia that became isolated during the

most recent glacial minimum. Off the southeast coast of Peninsular Malaysia lies the extensive Seribuat Archipelago, which contains 62 islands extending along the northern and southern shores of the states of Johor and Pahang, respectively (Fig. 6). Over a century of research has indicated that the mountain ranges of Peninsular Malaysia are regions of high herpetological diversity and endemism (e.g., Boulenger 1900a,b; Smith 1922a, 1935; Smedley 1931c; Grandison 1972; Dring 1979; Hallerman & McGuire 2001; Lim *et al.* 2002; Norsham & Lim 2002; Das & Norsham 2003; Leong & Lim 2003; Das *et al.* 2004; Sanders *et al.* 2004; Vogel *et al.* 2004; Grismer *et al.* 2006b, 2008a, 2009a,b,c; Grismer 2007a, 2008a; Matsui & Ibrahim 2006; Norhayati 2007; McLeod & Wood *et al.* 2008a; Chan *et al.*, 2009). Recent studies are now beginning to reveal that an equally, if not more impressive degree of diversity and endemism occurs in the associated offshore archipelagos. This becomes germane as the results from ongoing expeditions on Pulau Langkawi (Grismer & Norhayati 2008; Grismer *et al.* 2006d, 2008c; Grismer & Chan 2010), the Perhentian Archipelago (Grismer & Chan 2008, Grismer *et al.* 2009b, and those records reported herein), the Redang Archipelago (reported herein), the Tenggol Archipelago (reported herein), and especially in the Seribuat Archipelago (see Grismer 2006a, 2011a; Grismer *et al.* 2006a, and references therein, and Grismer & Pan 2008) continue to emerge and consistently report new island records and new species previously unknown to science. Reported and reviewed here are the results from various expeditions to some of the archipelagos off the eastern coast of West Malaysia, and new records from the Perhentian, Redang, and Tenggol Archipelagos.

THE EASTERN ARCHIPELAGOS OF PENINSULAR MALAYSIA

The archipelagos of Peninsular Malaysia are proving to be major centers of herpetological endemism and diversity (Grismer & Chan 2008, Grismer *et al.* 2009a, Chan & Norhayati 2010). Off the northeast coasts of Peninsular Malaysia, flanking the state of Terengganu, lie the Redang and Perhentian Archipelagos (Fig. 6). Accounts of its herpetofauna have been published for only one island in the Perhentian Archipelago, Pulau Perhentian Besar, and these are only descriptions of two species (Grismer & Chan 2008, Grismer *et al.* 2009a). However, what fieldwork

has been done on these archipelagos is promising. In an unpublished report on the herpetofauna of the Pulau Perhentian Kecil, Pulau Perhentian Besar, and Pulau Redang, Tamblin *et al.* (2005) reported three species of frogs, 21 species of lizards, and eight species of snakes. Their study, however, was capture and release so the records were not accompanied by voucher specimens or photographs and thus remain unconfirmed. Farther south off the coast of southern Terengganu lies Pulau Tenggol. To date only two species of lizards have been reported from that island (Chan & Norhayati 2010). We report here on a collection of amphibians and reptiles acquired during recent fieldwork on all the islands in the Perhentian Archipelago from 18–20 October 2007, 11–12 March and 22–24 June 2008, and 13–15 September 2009 that confirms 22 of the species records reported by Tamblin *et al.* (2005) and adds seven unreported species. We also report the first published records from Pulau Redang and new records from Pulau Tenggol based on fieldwork conducted on 10–13 September 2009 and 7–9 September 2009, respectively.

PERHENTIAN ARCHIPELAGO

The Perhentian Archipelago contains 11 islands ranging from 0.01 to 8.7 km² in size. The smallest islands are covered with various components of coastal forest, whereas Perhentian Besar and Perhentian Kecil maintain large tracts of lowland dipterocarp forest (Grismer & Chan 2008, Grismer *et al.* 2009c). The islands of this archipelago have a granite basement and large boulder outcroppings (Fig. 7) which add a significant component to their environmental diversity. Reported below are the new species records. Table 4 lists the known herpetofauna.

Duttaphrynus melanostictus. – Several individuals of *D. melanostictus* (LSUDPC 4810–11) were seen during the evenings during all visits on the grounds of various guest facilities on Pulau Perhentian Besar. These specimens match the description of this species from Peninsular Malaysia (Berry 1975).

Ingerophrynus parvus. – Four males were heard calling from a congregation at the edge of a small rocky stream on Pulau Perhentian Kecil. A single specimen (LSUHC 8822) was collected. This specimen matches the diagnostic characteristics of this species reported by Grismer (2007b).

Kaloula pulchra. – Several individuals (LSUDPC 3497–98) were seen mating in man-made fountains during the evenings on all visits on the grounds of various guest facilities on Pulau Perhentian Besar.



FIG. 7. Interior lowland forest on Pulau Perhentian Besar, Perhentian Archipelago, Peninsular Malaysia.

These specimens match the description of this species from Peninsular Malaysia (Berry 1975).
Polydectes leucomystax. – This species was commonly observed on Perhentian Besar and Perhentian Kecil (LSUHC 8821) throughout the forest along trails and on the water tanks behind the guest facilities on both islands. These specimens match the description of this species from Peninsular Malaysia (Berry 1975).

TABLE 4. Herpetofauna of the Perhentian and Redang Archipelagos and Pulau Tenggol.

	Perhentian Besar	Perhentian Kecil	Susu Dara Besar	Susu Dara Kecil	Rawa	Seringgeh	Tokong Burong Besar	Redang	Tenggol
FROGS									
Bufonidae									
<i>Duttaphrynus melanostictus</i>	x							x	
<i>Ingerophrynus parvus</i>		x						x	
Microhylidae									
<i>Kaloula pulchra</i>	x							x	x
Rhacophoridae									
<i>Polydectes leucomystax</i>	x	x						x	x
<i>Theloderma lacin</i>	x	x							
Ranidae									
<i>Limnonectes blythii</i>								x	
<i>Limnonectes laticeps</i>								x	
<i>Hylarana erythraea</i>	x								
CAECILIANS									
Ichthyophiidae									
<i>Ichthyopsis</i> sp.	x								

TABLE 4. Continued.

	Perhen- tian Besar	Perhen- tian Kecil	Susu Dara Besar	Susu Dara Kecil	Rawa	Seringgeh	Tokong Burong Besar	Redang	Tenggol
LIZARDS									
Agamidae									
<i>Acanthosaura armata</i>	x	x						x	
<i>Bronchocela cristatella</i>	x	x						x	
<i>Draco formosus</i>									x
<i>Draco sumatranus</i>	x							x	
Gekkonidae									
<i>Cnemaspis kendallii</i>									x
<i>Cnemaspis perhentianensis</i>	x	x							
<i>Cyrtodactylus consobrinus</i>	x								
<i>Cyrtodactylus leegrimeri</i>									x
<i>Cyrtodactylus quadrivirgatus</i>	x								
<i>Gehyra mutilata</i>	x	x	x		x			x	x
<i>Gekko gekko</i>	x?	x						x	
<i>Gekko monarchus</i>	x							x	x
<i>Gekko smithii</i>	x								
<i>Hemidactylus frenatus</i>	x	x	x		x	x	x	x	x
<i>Hemidactylus platyurus</i>	x								
<i>Lepidodactylus lugubris</i>				x					
<i>Ptychozoon kuhli</i>	x								x
<i>Ptychozoon lionotum</i>	x							x	
Scincidae									
<i>Dasia olivacea</i>	x							x	x
<i>Eutropis longicaudata</i>	x							x	
<i>Eutropis multifasciata</i>	x							x	x
<i>Lygosoma quadrupes</i>					x				
<i>Lygosoma bowringii</i>	x								
<i>Sphenomorphus perhentianensis</i>	x								
Varanidae									
<i>Varanus nebulosus</i>	x								
<i>Varanus salvator</i>	x	x	x		x			x	x
SNAKES									
Typhlopidae									
<i>Ramphotyphlops braminus</i>	x								
Pythonidae									
<i>Broghammerus reticulatus</i>	x		x					x	x
Colunridae									
<i>Ahaetulla prasina</i>	x							x	x
<i>Boiga dendrophila</i>	x							x	
<i>Chrysopelea ornata</i>	x								
<i>Dendrelaphis pictus</i>	x							x	
<i>Dryocalamus subannulatus</i>	x								
<i>Gonyosoma oxycephalum</i>	x								
<i>Lycodon capucinus</i>	x								
<i>Lycodon subcinctus</i>	x								
Viperidae									
<i>Tropidolaemus wagleri</i>	x								

Theloderma licin. – One specimen (LUSHC 8820) was collected from within a small, water-filled treehole 1.5 m above the ground in lowland dipterocarp forest on Pulau Perhentian Kecil. Two additional individuals (LSUHC 9410–11) were found in a similar situation on Pulau Perhentian Besar. All three specimens match the description of this species by McLeod & Norhayati (2007). These are the first insular records for this species.

Hylarana erythraea. – Two specimens (LSUHC 8702–03) were collected from a small natural drainage along a trail through disturbed forest on Pulau Perhentian Besar. These specimens match the description of this species from Peninsular Malaysia (Berry 1975).

Ichthyophis sp. – A juvenile (LSUDPC 4155) was collected during the day following a rain shower from a shallow pool on a trail through disturbed forest on Pulau Perhentian Besar. Adults were observed beneath rocks in a shallow stream coursing through lowland dipterocarp forest.

Acanthosaura armata. – Several individuals were observed on all sizes of trees during the day and night throughout the forest on Pulau Perhentian Besar (LSUHC 8726–33). Only a single individual (LSUHC 8823) was seen on Pulau Perhentian Kecil. This population is unique with respect to other *A. armata* in that they have a unicolor, light brown dorsal pattern (Grismer 2011b). These specimens have the diagnostic characters listed for this species in Wood *et al.* (2009).

Bronchocela cristatella. – Several specimens were observed on Perhentian Besar (LSUHC 8737) and Perhentian Kecil islands (LSUDPC 4696) in disturbed vegetation along the trails. These specimens match the diagnosis for this species in Diong & Lim (1998).

Draco sumatranus. – Three individuals were seen on trees in open areas along the forest trails through coastal vegetation on Pulau Perhentian Besar. The specimen collected (LSUHC 8692) matches Muster's (1983) diagnosis of this species.

Cryptodactylus quadrivirgatus. – This species was observed at night on low vegetation in lowland dipterocarp forest on Pulau Perhentian Besar. These specimens (LSUHC 9057–58) have the diagnostic character states for this species listed in Grismer *et al.* (2008c).

Gehyra mutilata. – This species was observed on walls and other man-made structures on both Perhentian Besar and Perhentian Kecil islands (LSUHC

8693, 8706–07). Another individual was collected from within a rock crack on Pulau Susu Dara Besar (LSUHC 9067) and another was observed on rocks beneath coastal vegetation on Pulau Rawa (LSUDPC 5209). These specimens match Manthey & Grossmann's (1997) description of this species.

Gekko gekko (LSUHC 8825). – This species exists in surprising densities in the resorts on Pulau Perhentian Kecil. Tamblyn *et al.* (2005) report its occurrence on Pulau Perhentian Besar but we have only observed *G. smithii* on that island. These specimens match Manthey & Grossmann's (1997) description of this species.

Gekko monarchus. – This species was relatively common at night on the granite boulders in lowland dipterocarp forest on Perhentian Besar (LSUHC 8691) and Perhentian Kecil islands (LSUDPC 4186). During the day, lizards were found beneath granite exfoliations. These specimens match Manthey & Grossmann's (1997) description of this species.

Gekko smithii. – Several lizards were observed on the granite boulders in the lowland dipterocarp forest on Pulau Perhentian Besar. All specimens (LSUHC 8690, 8696) match the description of this species in Manthey & Grossmann (1997).

Hemidactylus frenatus. – This lizard was found in all habitats on Perhentian Besar (LSUDPC 4672) and Perhentian Kecil Islands (LSUHC 8826), on trees on Pulau Rawa (LSUHC 9065) and Susu Dara Besar (LSUHC 9066), beneath trash on the beach on Pulau Seringgeh (LSUHC 9069), and under rocks on Pulau Tokong Burong Besar (LSUHC 9063–64). These specimens match Manthey & Grossmann's (1997) description of this species.

Hemidactylus platyurus (LSUDPC 5000). – This species was commonly found during the day on Pulau Perhentian Besar beneath exfoliations of granite boulders in lowland dipterocarp forest.

Lepidodactylus lugubris. – A specimen (LSUHC 9068) was found within a rock crack during the day on Pulau Susu Dara Kecil. As on small islands in the Seribu Archipelago, this species does not co-occur with *Hemidactylus frenatus* unless it is restricted to the intertidal zone (Grismer *et al.* 2006a). The specimen matches the description of this species in Manthey & Grossmann (1997).

Ptychozoon kuhli. – This species was commonly observed at night along the trails through the lowland dipterocarp forest of Pulau Perhentian Besar. As many as seven individuals were seen in one night. These

specimens (LSUHC 8674, 8708) match the description of this species in Manthey & Grossmann (1997).

Pychozoon lionotum. – This species was observed at night along the trails through the lowland dipterocarp forest of Pulau Perhentian Besar in syntopy with *P. kuhli*. These specimens (LSUHC 8709, 9059) match the description of this species in Manthey & Grossmann (1997).

Dasia olivacea. – A single individual (LSUDPC 5154–56) was observed on the trunk of a coconut palm along the beach on Pulau Perhentian Besar. The color pattern of this specimen matches the description of this species in Manthey & Grossmann (1997).

Eutropis longicaudata. – A single specimen (LSUDPC 3495) was collected from beneath trash on the beach on Pulau Perhentian Besar which matches the color pattern description of this species in Lim (1998).

Eutropis multifasciata. – This species was commonly seen during the day foraging along the forest floor in lowland dipterocarp forest on Pulau Perhentian Besar. One individual was even found at night in a small stream. These specimens (LSUHC 8704, 9061) match the description of this species in Lim (1998).

Lygosoma quadrupes. – A single specimen was found beneath a log buried in leaf litter in coastal forest on Pulau Rawa (Fig. 8). This specimen (LSUHC 9062) matches the description of this species in Lim (1998).

Varanus nebulosus. – Individuals were seen foraging at the forest edge behind dwellings on the beach on Pulau Perhentian Besar. The color pattern of these individuals (LSUDPC 1136) matches the description of this species in Manthey & Grossmann (1997).

Varanus salvator. – This species was common along the beaches on Perhentian Besar and Perhentian Kecil islands. Tracks were observed on the beach on Pulau Rawa and Susu Dara Besar. The color pattern of these individuals (LSUDPC 2819) matches the description of this species in Manthey & Grossmann (1997).

Ramphotyphlops braminus. – A single specimen (LSUHC 8883) from Pulau Perhentian Besar was collected beneath debris along the beach at the forest edge. This specimen matches the description of this species in Tweedie (1983).

Broghamerus reticulatus. – One specimen (LSUDPC 0197) was found crawling along the beach near the water's edge at night on Pulau Perhentian Besar. Local inhabitants report that this species is also on Pulau Susu Dara Besar and its presence there

is considered here to be unconfirmed. This specimen matches the description of this species in Tweedie (1983).

Ahaetulla prasina (LSUDPC 1444). – This species was commonly seen during the day in the ornamental vegetation planted at the resorts on Pulau Perhentian Besar. This specimen matches the description of this species in Tweedie (1983).

Boiga dendrophila. – A large specimen (LSUDPC 4820) was found at night crawling in a cement drain shortly after an afternoon rain shower on Pulau Perhentian Besar, which confirms the record for this species by Tambyln *et al.* (2005).

Lycodon capucinus. – One specimen (LSUHC 8827) was found beneath debris on the beach on Pulau Perhentian Besar. This specimen matches the description of this species in Tweedie (1983).

Lycodon subcinctus. – A large specimen was collected during the evening while crawling along the edge of a small stream on Pulau Perhentian Besar. The specimen escaped before being photographed or preserved. It is therefore considered an unconfirmed sighting.

Tropidolaemus wagleri. – Several specimens were observed during the night in low vegetation in the lowland dipterocarp forest of Pulau Perhentian Besar. One individual (LSUDPC 4566) observed during the day was perched 1.5 m above the ground on a branch. It remained in the same spot for at least 48 hours. The color pattern of this specimen matches the description of this species in Manthey & Grossmann (1997).

Much of the herpetofauna of this archipelago is a subset of that of the adjacent peninsula in the state of Terengganu (Dring 1979). However, the presence of the endemic species *Cnemaspis perhentianensis* and *Sphenomorphus perhentianensis* are clear indications of the understudied nature of this archipelago. The presence of *Ichthyophis* is the first record of this genus in northeastern Peninsular Malaysia and it is likely the population in the Perhentian Archipelago will prove to be a new species. A decision will follow a molecular analysis.

REDANG ARCHIPELAGO

The Redang Archipelago contains nine islands dominated by the large, butterfly shaped, granite-based island of Redang (90 km²). Pulau Redang reaches 359 meters in elevation and some primary forest remains on its upper peaks. Lowland rainforest dominates the interior of the island (Fig. 9) and



FIG. 8. Interior coastal forest on Pulau Rawa, Perhentian Archipelago, Peninsular Malaysia.



FIG. 9. Rocky streambed in the interior of Pulau Redang, Redang Archipelago, Peninsular Malaysia.

mangrove communities (Fig. 10) and open beaches (Fig. 11) are common on the northern coast. Unfortunately, tourism and a growing local population are impacting much of its coastline and forested interiors. The island has been designated as an important conservation site for sea turtles, and unpublished studies on the island's herpetofauna strongly suggest it is in need of exploration. The results of preliminary fieldwork conducted on 10–13 September 2009 augment and confirm earlier reports on this herpetofauna presented in an unpublished report by Tamblyn *et al.* (2005) based on an unpublished Malaysian Nature Society survey of 1990 which reported only four species of lizards being observed. Below we add eight species of lizards, six species of frogs, and four species of snakes collected along the Redang Reef Trail on the eastern side of the island. Table 4 lists the known herpetofauna.

Duttaphrynus melanostictus. – Several individuals of *D. melanostictus* were seen during the night on jungle trails and on the grounds of various guest facilities. One specimen (LSUHC 9394) was collected which matches the description of this species from Peninsular Malaysia (Berry 1975).

Ingerophrynus parvus. – Two specimens (LSUHC 4399–4400) were collected at the edge of a puddle in a disturbed area at the head of a trail. These specimens match the diagnostic characteristics of this species reported by Grismer (2007b).

Kaloula pulchra. – A single individual (LSUHC 9403) was found 4 m above the ground on the side of a tree along the forest trail. It matched the description of this species from Peninsular Malaysia (Berry 1975).

Limnonectes blythii. – Several specimens were seen within and along the edge of a small stream at night. Two specimens (LSUHC 9384, 9404) were collected that match the description of this species in Berry (1975).

Limnonectes laticeps. – This species (LSUHC 9295–9398) was found at night along the edges of a rocky stream paralleling the Redang Reef Trail. These specimens match the description of this species in Berry (1975).

Polypedates leucomystax. – Several frogs uttering the iconic “wet fart” call of this species were heard throughout the forest along a small stream. None were collected and thus this record remains unconfirmed.

Acanthosaura armata. – This species (LSUHC 9385–89) was abundant and observed on the trunks

of both large and small trees throughout the forest. Like the individuals from Pulau Perhentian Besar and Pulau Perhentian Kecil, the color pattern on the lizards from this population is generally unicolor. Lizards from this population have the diagnostic character states for *A. armata* listed in Wood *et al.* (2009). This population was listed in Tamblyn *et al.* (2005).

Bronchocela critatella. – This species was common on tree trunks in both disturbed areas and along the forest trail. One specimen collected (LSUHC 9390) has the diagnostic character states of this species listed in Diong & Lim (1998).

Draco sumatranus. – This species was common on tree trunks in both disturbed areas and along the forest trail. Two specimens collected (LSUHC 9393, 9406) have the diagnostic character states of this species listed in Muster (1983). This confirms the record of this species in Tamblyn *et al.* (2005).

Gehyra mutilata (LSUDPC 4086). – This species was observed on walls and other man-made structures as well as on tree trunks and leaves in the forest. The color pattern of this specimen matches the description of this species in Manthey & Grossmann (1997).

Gekko gekko (LSUDPC 3438). – This species was common on the sides of houses and tree trunks in disturbed areas as well as on rock outcrops in the forest. The color pattern of this specimen matches the description of this species in Manthey & Grossmann (1997).

Gekko monarchus (LSUDPC 2657). – This species was relatively common at night on the granite boulders in the forest. The color pattern of this specimen matches the description of this species in Manthey & Grossmann (1997).

Hemidactylus frenatus. – This lizard was common on all man-made structures. One individual collected (LSUHC 9407) matches the description of this species in Manthey & Grossmann (1997).

Pythozoon lionotum. – A single specimen (LSUHC 9409) was observed at night approximately 1.5 m above the ground on the side of tree in a disturbed area. It matches the description of this species in Manthey & Grossmann (1997).

Dasia olivacea (LSUDPC 9391). – Several skins were observed during the day on the sides of trees and buildings in the resort areas. The color pattern of this specimen matches the description of this species in Lim (1998).

Eutropis longicaudata. – A juvenile specimen was observed basking on rocks in a fountain in a resort.



FIG. 10. Mangrove-dominated estuary on Pulau Redang, Redang Archipelago, Peninsular Malaysia.



FIG. 11. Beach habitat on Pulau Redang, Redang Archipelago, Peninsular Malaysia.

It escaped capture and was not photographed. Its record thus remains unconfirmed.

Eutropis multifasciata. – Several specimens were seen foraging throughout the leaf litter on the forest floor during the day. The specimen collected (LSUHC 9392) matches the description of this species in Lim (1998). This confirms the record of this species in Tamblyn *et al.* (2005).

Varanus salvator (LSUDPC 5263). – Several specimens were observed along the small, brackish waterways near the coast in both disturbed and undisturbed areas. We also observed several tracks in mangrove areas. This confirms the record of this species in Tamblyn *et al.* (2005).

Abaetulla prasina. – This specimen was not observed but reported as present by several of the local inhabitants. Its status thus remains unconfirmed.

Boiga dendrophila. – We were shown photographs of individuals of this species from the island by the staff at the sea turtle breeding center.

Dendrelaphis pictus. – One specimen (LSUHC 9413) matching the description of this species in Vogel & Van Rooijen (2007, 2008) was found sleeping approximately 2 m above the ground in a small tree in a disturbed area.

Broghammerus reticulatus. – We were shown photographs of individuals of this species from the island by the staff at the sea turtle breeding center.

TENGGOL ARCHIPELAGO

The Tenggol Archipelago comprises a small group of seven rocky islands lying 26 km off the coast of southern Terengganu and represents the southernmost islands of Terengganu's Marine Parks. The rocky interiors of these islands are pristine and unexplored and most islands are covered in primary forest. The largest island of the archipelago, Pulau Tenggol, is less than 6 km² in area. Its steep interior reaches nearly 50 m in elevation, giving rise to three main peaks. There is one large beach on the west side of the island and a smaller beach along the east coast. Its pristine interior is covered by coastal and lowland forest that provides a dense canopy for the extensive rocky outcroppings that dominate the island's landscape (Fig. 12). Although there is no permanent fresh water, at least two species of amphibians are present and the varied interior offers numerous microhabitats that support a relatively diverse reptile fauna. The results of the first herpetofaunal survey of Pulau Tenggol are reported here and augment the findings

reported in Chan & Norhayati (2010). This survey was concentrated along the hills (4°48.51'N, 103°40.73'E) behind the beach at Air Tawar Bay along the west side of the island. Table 4 lists the known herpetofauna.

Kaloula pulchra. – Individuals were seen in the vicinity of the chalets and on the forest floor. The specimen collected (LSUHC 9375) matches the description of this species by Berry (1975).

Polypedates leucomystax. – One specimen was heard calling from near the chalets. Its presence remains unconfirmed.

Draco formosus. – This species was very common and seen on the trunks of many trees in all habitats. This is a species usually restricted to forest areas, but here it was quite common on trees along the beach. The specimens collected (LSUHC 9360–61, 9365–66) match the description of this species in Muster (1983).

Cnemaspis kendallii. – This species was found in only one small area in the interior of the forest. Here individuals were seen abroad both during the day and night on the trunks and buttresses of trees and on rocks. The specimens collected (LSUHC 9376–77, 9380, 9382) match the description of this species in Grismer *et al.* (2008a).

Cyrtodactylus leegrimeri. – This endemic species was described by Chan & Norhayati (2010). Lizards were abundant and ubiquitous on the island, occurring in every conceivable terrestrial and arboreal habitat.

Gehyra mutilata. – One specimen was collected (LSUHC 9381) from the leaf of a small tree approximately 1 m above the ground in lowland forest. It matches the description of this species in Manthey & Grossmann (1997).

Gekko monarchus. – Several specimens of this species were seen on the chalets and the rocks surrounding the chalets. This species was first reported from Pulau Tenggol by Chan & Norhayati (2010).

Hemidactylus frenatus. – Several specimens of this species were seen on the chalets and the rocks surrounding the chalets. The specimen collected (LSUHC 9383) matches the description of this species in Manthey & Grossmann (1997).

Ptychozoon kuhli. – One individual (LSUHC 9362) was found during the day on the roof of a chalet and matches the description of this species in Manthey & Grossmann (1997).

Dasia olivacea. – Several individuals were seen on trees along the beach and on the roofs of various



FIG. 12. Interior lowland forest on Pulau Tenggol, Tenggol Archipelago, Peninsular Malaysia.

chalets. The specimens collected (LSUHC 9363, 9367) match the description of this species in Lim (1998).

Eutropis multifasciata. – Several specimens were seen foraging on the leaf litter during the day and crawling among the rocky outcrops. We also found three individuals at night sleeping on the sides of trees 2–3 m above the ground. The specimens collected (LSUHC 9368–69) match the description of this species in Lim (1998).

Varanus salvator. – We observed a juvenile near the water's edge as it was foraging among the rocks. It was not collected or photographed and thus the record remains unconfirmed.

Ahaetulla prasina. – This specimen was not observed but reported as present by several of the local inhabitants. Its status thus remains unconfirmed.

Broghammerus reticulatus. – One specimen (LSUDPC 5262) was captured by the staff of the resort as it continually returned to the area. The color pattern of this specimen matches the description of this species in Tweedie (1983).

SERIBUAT ARCHIPELAGO

The Seribuat Archipelago lies off the southeast coast of Peninsular Malaysia and has an environmental diversity that is unparalleled by any other island group in Peninsular Malaysia (Grismer *et al.* 2001a,b, 2006a; Grismer 2011a; Youmans *et al.* 2002; Escobar *et al.* 2003a,b; Wood *et al.* 2003a,b, 2004a,b; J. Grismer *et al.* 2004; Tamblyn *et al.* 2005; Grismer 2006a, 2008b; Fig. 6). This is paramount to the generation and maintenance of its herpetofaunal diversity and its broad array of adaptive types (Grismer *et al.* 2006a). The large islands (> 4.0 km²) such as Aur, Babi Besar, Pemanggil, Tinggi, Tioman, and Sibu generally maintain extensive tracts of primary dipterocarp forest (Fig. 13). The largest of these, Tioman and Tinggi, also maintain significant sources of permanent fresh water in the form of streams, which harbor aquatic and riparian species not found on the other islands. Pulau Tioman even has a small river system, Sungai Mentawak (Fig. 14), which serves as the only locality in the archipelago for the frog *Hylarana picturata*. Conversely, many of the very



FIG. 13. Interior lowland forest on Pulau Tioman, Seribu Archipelago, Peninsular Malaysia.

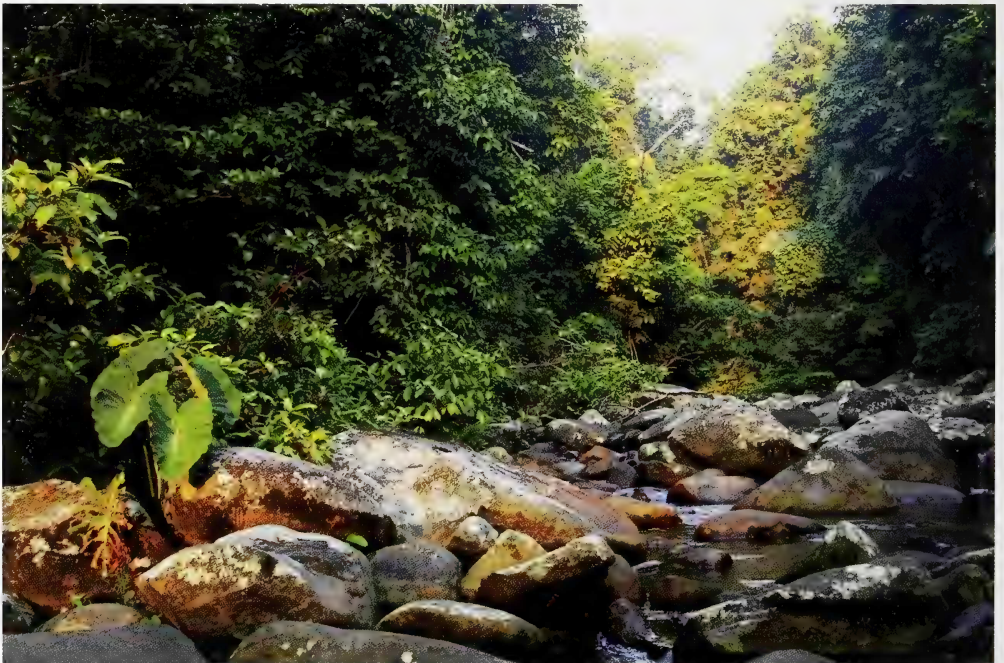


FIG. 14. Sungai Mentawak on Pulau Tioman, Seribu Archipelago, Peninsular Malaysia.



FIG. 15. Windswept Pulau Tokong Burong, Seribuat Archipelago, Peninsular Malaysia.

small islands ($> 0.03 \text{ km}^2$) such as the “Tokongs” are little more than wind-blown, arid, rocky outcrops rising precipitously out of the ocean, supporting only grasses and low-growing shrubs (Fig. 15). But here too, potentially endemic species have been found which occur nowhere else in the archipelago (Grismer 2006a,b). The intermediate-sized islands may be barren (P. Layak), forested (P. Babi Hujung), or combinations of both, such as in the Seribuat group (*sensu* Grismer *et al.* 2006a), and they may or may not support ephemeral bodies of fresh water. Many of the islands in the archipelago, both large and small, are fringed with broad stands of mangroves.

The islands of the Seribuat Archipelago are land-bridge islands that formerly comprised a series of at least three low mountain ranges paralleling the more extensive ranges running the length of the adjacent Malay Peninsula. The summits of these ranges became transformed into a series of three parallel island arcs following the most recent rise in sea level which began to inundate the Sunda Shelf 21 kbp (Voriss 2000, Inger & Voriss 2001, Sathiamurthy & Voriss 2006). It is thus likely that much of the herpeto-

fauna of these islands had a vicariant origin, being effectively isolated on these summits prior to their isolation by rising sea levels. Recent phylogenetic studies (Brown *et al.* in press, Grismer *et al.* in press) are beginning to augment a wider body of evidence (Kottelat 1990; Ng *et al.* 1999; Tan & Mohamed 1999; Yeo & Ng 1999; Yeo *et al.* 1999; Grismer *et al.* 2003, 2004b, 2006c; Leong *et al.* 2003) showing that many of the endemics on the outermost island arc are actually more closely related to species from Borneo, approximately 540 km to the southeast, than to taxa on the adjacent Malay Peninsula, just 28 km to the west. This isolation, coupled with genetic drift and the selection pressures attendant with living on small islands, was likely the driving force promoting evolutionary change in a number of these newly isolated populations. As a result, a significant portion of the herpetofauna in this archipelago is endemic (see Grismer 2011a, Grismer *et al.* 2006a, Sodhi *et al.* 1999).

Like other regions within tropical megadiversity hotspots (Myers *et al.* 2000), the herpetofauna of Seribuat Archipelago is relatively diverse and undergoing a rapid increase in its content as recent and

ongoing fieldwork progresses. This trend has been particularly evident since 2001, with 186 new insular species records being added (Grismer 2006a, Grismer *et al.* 2006a; Table 2 and references therein) and at least 13 new species discovered and described, increasing the total diversity of the archipelago by 60% since the major contributions of Lim & Lim (1999) and Hien *et al.* (2001). Currently there are 24 species of frogs, one species of caecilian, one species of turtle, 41 species of lizards, and 44 species of snakes distributed across the 62 islands of this 100-km-long archipelago (see Grismer 2011a). Such dramatic increases in diversity over such a relatively short period of time clearly indicate that these regions remain significantly understudied and their actual diversity has yet to be realized.

SOUTHERN PENINSULAR MALAYSIA

As delineated by Grismer & Pan (2008), southern Peninsular Malaysia occupies approximately 1620 km². It extends from the city of Melaka, Melaka (2°11'57"N, 102°15'16"E) on the west coast to Kampong Leban Condong, Pahang (2°52'19"N, 103°26'03"E) on the east coast, and southward through Singapore (1°15'05"N, 103°49'54"E; Fig. 6). This area occupies roughly the entire state of Johor and the southern section of the state of Pahang and includes all low-lying areas below 150 m as well as the mountainous areas encompassing Gunung Ledang (1276 m) in northeastern Johor, Endau-Rompin in southern Pahang and northern Johor, reaching 1036 m at Gunung Besar, and a system of mountains in central Johor dominated by Gunung Berlumut (1010 m) in the north and extending southward approximately 57 km to Bukit Sisek (430 m) in the south.

Originally, continental southern Peninsular Malaysia was an expansive region of lowland rainforest punctuated by isolated mountains and mountain ranges. Currently, the majority (~65%) of the lowland rainforest has been converted into rubber tree and oil palm plantations. This is especially true of the western half and southern third. Continuous lowland rainforest remains in the northeastern third as well as a few scattered patches in the west. Peat swamp-forests are found in isolated patches in the east and the west, and freshwater swampforests dominate the southeastern corner. Fringing the coastal areas are isolated stands of mangrove swamps that are particularly noteworthy in the south. Intact montane forest exists in all areas above 300 m, most notably in En-

dau-Rompin, Johor; the Gunung Berlumut system, and Gunung Ledang. Focused efforts in continental southern Peninsular Malaysia since 2005 have led to the discovery and description of at least five new species, the rediscovery of an extremely rare species (Daicus & Hashim 2004; Grismer & Leong 2005; Grismer 2006c, 2007b; Grismer *et al.* 2007c, 2008a,c; Wood *et al.* 2008b), and an increase in the diversity of the herpetofauna of Endau-Rompin National Park by at least 33% (Wood *et al.* 2008b). To date, five families of frogs representing at least 53 species and one family of caecilian representing an unknown number of species (see below) are confirmed for southern Peninsular Malaysia (Berry 1975, Wood *et al.* 2008b). Not including caecilians, this represents approximately 59% of all the species of amphibians known from Peninsular Malaysia (based on Das & Norsham 2007 and Chan *et al.* 2010) in less than 14% of the total area of the country. The reptilian fauna is even more diverse, with three families of terrestrial and freshwater turtles representing 11 species, eight families of lizards representing 61 species, eight families of non-marine snakes representing 90 species, and one family of crocodilian representing one species (Grismer & Pan 2008; Table 1). Collectively this represents approximately 65% of the reptilian fauna of Peninsular Malaysia (based on Das & Norsham 2007 and Grismer 2008c, Grismer 2011b).

Perhaps of greater importance, however, is role southern Peninsular Malaysia plays in harboring endemic species. Since the description of *Cyrtodactylus sunderi* (Smith 1925), two new species of frogs (*Ansonia endauensis* [Grismer 2006c] and *Ingerophrynus gollum* [Grismer 2007b]) and two new species of lizard (*Cyrtodactylus semenanjungensis* [Grismer & Leong 2005] and *C. pantiensis* [Grismer *et al.* 2008c]) have been described. Additionally, there is another new species of snake (*Macrocaltamus* sp.) in the process of being described. Based on the results of over a century of fieldwork in montane regions of central and northern Peninsular Malaysia (Boulenger 1900a,b; Smith 1922a, 1935; Smedley 1931c; Grandison 1972; Dring 1979; Hallerman & McGuire 2001; Lim *et al.* 2002; Norsham & Lim 2002; Das & Norsham 2003; Leong & Lim 2003; Das *et al.* 2004; Sanders *et al.* 2004; Vogel *et al.* 2004; Grismer 2006b, 2007a, 2008a; Matsui & Ibrahim 2006; McLeod & Norhayati 2007; Wood *et al.* 2008a), it is certain that field surveys in the montane regions of southern Peninsular Malaysia will result in the

discovery of additional species, many of which are likely to be endemic, and may raise the level of endemism of these habitat-islands to that of the islands in the adjacent Seribu Archipelago.

The documented herpetofaunal diversity of southern Peninsular Malaysia will undoubtedly increase as a result of the ongoing efforts of field biologists working in this area. These increases will be most dramatic in the severely understudied areas, as suggested by the recent findings from Endau-Rompin, Johor, and Gunung Pantii (Grismer & Leong 2005; Grismer 2006c, 2007b; Grismer *et al.* 2008a; Wood *et al.* 2008b). Surveys will also begin in earnest in the upland areas of Endau-Rompin, Gunung Berlumut, and Gunung Ledang, and it is expected that many additional records and potentially new species will be discovered there as well. All these areas should be set aside for purposes of studying and preserving the biodiversity of this region in an effort to protect a significant portion of Malaysia's natural heritage. Additionally, protected areas such as these can be immensely useful for serving as model systems in evaluating the myriad of complex nuances involved in efficient and cost effective ecosystem management which can subsequently be applied to other imperiled regions of Southeast Asia.

DISCUSSION

The data presented here suggest that the herpetofaunal composition of the borderlands fringing the Sunda Shelf from Vietnam to Borneo has been shaped by historical fluctuations in the climate of Southeast Asia and episodic marine transgressions of the South China Sea for at least the last five million years. This has culminated in a diverse herpetofauna and significant degrees of endemism, particularly in montane areas and archipelagos. Unfortunately this herpetofauna still remains woefully understudied. This is most evident in Peninsular Thailand, whose mountainous spine is just now beginning to reveal a large array of endemic species (e.g., Chan-ard *et al.* 2008, Grismer *et al.* 2010c). Although a few species records exist for some of the islands off the east coast of Peninsular Thailand and the southern coast of western Thailand in general works (e.g., Boulenger 1912; Smith 1922b; Bourret 1936; 1937–1941, 1941, 1942; Ouboter 1986; Taylor 1962, 1963, 1965; Chan-ard 2003, and references therein), there are still hundreds of islands fringing this nearly 2000 km of coastline that remain virtually unexplored. Similarly, there are no records of amphibians or rep-

tiles from 16 or so islands off the coast of southern Cambodia. We have seen photographs of lizards and frogs (which we cannot identify) from a few of these islands, but nothing has been published. Additional work is also needed in the Anambas and Natunas archipelagos lying between Borneo and the Malay Peninsula (Fig. 1). No focused survey work has been done there since Smedley (1928; 1931a,b) and the most recent comprehensive work is merely a checklist (Leong *et al.* 2003).

Much the same can be said about the island of Borneo. Despite the popular pocket guides (Das 2004, 2006, 2007), books (Inger & Tan 1996, Lim & Das 1999, Stuebing & Inger 1999, Malkmus *et al.* 2002, Inger & Stuebing 2005), and scattered species descriptions (see Das & Norsham 2007 and references therein) on the herpetofauna of northern Borneo, the majority of this island's herpetofauna remains largely unstudied.

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REFERENCES

- Attwood, S.W., & D.A. Johnston. 2001. Nucleotide sequence differences reveal genetic variation in *Neotrichia aperta* (Gastropoda: Pomatiopsidae), the snail host of schistosomiasis in the Lower Mekong Basin. *Biological Journal of the Linnean Society* 73: 23–41.
- Bain, R.H., Lathrop, A., Murphy, R.W., Orlov, N.L., & T.C. Ho. 2003. Cryptic species of a cascade frog from Southeast Asia: taxonomic revisions and descriptions of six new species. *American Museum Novitate* 3417: 1–60.
- Berry, P.Y. 1975. The Amphibian Fauna of Peninsular Malaysia. Kuala Lumpur.
- Bezuijen, M.R., Vinn, B., & L. Sieng. 2009. A collection of amphibians and reptiles from the Mekong River, north-eastern Cambodia. *Hamadryad* 34: 135–164.
- Bird, M.I., Taylor, D., & C. Hunt. 2005. Paleoenvironments of insular Southeast Asia during the last glacial period: a savanna corridor in Sundaland? *Quaternary Science Reviews* 24: 2228–2242.
- Boulenger, G.A. 1900a. Descriptions of new batrachians and reptiles from Larut Hills, Perak. *Annals of the Magazine of Natural History* 6: 186–193.
- Boulenger, G.A. 1900b. Description of new reptiles from Perak, Malay Peninsula. *Annals of the Magazine of Natural History* 5: 306–308.
- Boulenger, G.A. 1903. Report on the batrachians and reptiles. Pp.131–176 in *Fasciculi Malayenses*. Anthropological and zoological results of an expedition to Perak and the Siamese Malay States 1901–1902, undertaken by Nelson Annandale and Herbert C. Robinson. Vol. 1. Zoology. Liverpool.
- Boulenger, G.A. 1908. Report on the Gunung Tahan Expedition, May–Sept. 1905. III. Fishes, batrachians, and reptiles. *Journal of the Federated States Museum* 3: 61–69.
- Boulenger, G.A. 1912. A Vertebrate Fauna of the Malay Peninsula from the Isthmus of Kra to Singapore Including Adjacent Islands. London.
- Bourret, R. 1936. *Les Serpentes de L'Indochine*. Toulouse. Two volumes.
- Bourret, R. 1937–1941. *Les Lézards de L'Indochine*. Frankfurt am Main. Reprinted in 2009.
- Bourret, R. 1941. *Les Tortues de L'Indochine*. Note de l'Institut Océanographique de l'Indochine 38: 1–235.
- Bourret, R. 1942. *Les Batraciens de l'Indochine*. *Mémoires de l'Institut Océanographique de l'Indochine* 6: 1–547.
- Butler, A.L. 1902. On recent additions to the batrachian fauna of the Malay Peninsula. *Proceedings of the Zoological Society of London* 1902: 188–190.
- Butler, A.L. 1904. A list of the batrachians known to inhabit the Malay Peninsula, with some remarks on their habits and distribution. *Journal of the Bombay Natural History Society* 15: 193–205 and 387–402.
- Campden-Main, S.M. 1969. The status of *Oligodon taeniatatus* (Günther), 1861, and *Oligodon mouboti* (Boulenger), 1914 (Serpentes, Colubridae). *Herpetologica* 25: 295–299.
- Cantor, T.E. 1847. Catalog of reptiles inhabiting the Malay Peninsula and islands, collected or observed by Theodore Cantor, Esq., M.D. Bengal Medical Service. *Journal of the Asiatic Society of Bengal* 16: 607–656, 897–952, 1026–1078.
- Chan, K.O., Grismer, L.L., Norhayati, A., & D. Belabut. 2009. A new species of *Gastrophrynoides* (Anura: Microhylidae): an addition to a previously monotypic genus and a new genus for Peninsular Malaysia. *Zootaxa* 2124: 63–68.
- Chan, K.O., & Norhayati, A. 2010. A new insular species of *Cyrtodactylus* (Squamata: Gekkonidae) from north-eastern Peninsular Malaysia, Malaysia. *Zootaxa* 2389: 47–56.
- Chan-ard, T. 2003. A Photographic Guide to Amphibians in Thailand. Bangkok.
- Chan-ard, T., Cota, M., Mekchai, S., & S. Laoteow. 2008. A new species of the genus *Pseudocalotes* (Squamata: Agamidae) from peninsular Thailand. *The Thailand Natural History Museum Journal* 3: 25–31.
- Chan-ard, T., Grossman, W., Gumprecht, A., & K.-D. Schultz. 1999. *Amphibians and Reptiles of Peninsular Malaysia and Thailand*. Wuersele.
- Cox, M.J. 1991. *The Snakes of Thailand and Their Husbandry*. Malabar, Florida.
- Daicus, B., & R. Hashim. 2004. Herpetofauna of the western region of Endau-Rompin, Johore, Peninsular Malaysia. *Malaysian Journal of Science* 23: 65–72.

- Daltry, J.C., & D. Chheang. 2001. Reptiles. p. 252. in Daltry, J.C. & F. Mombert (eds.). Cardamom Mountains Biodiversity Survey 2000. Fauna & Flora International, Cambridge, England.
- Darevsky, I.S. 1999. The herpetofauna of some offshore islands of Vietnam, as related to that of the adjacent mainland. Pp. 27–42 in H. Ota (ed.) Tropical Island Herpetofauna. Origin, Current Diversity, and Conservation. Amsterdam.
- Darevsky, I.S., & N.N. Szczerbak. 1997. A new gecko of the genus *Gonydactylus* (Sauria: Gekkonidae) with a key to the species from Vietnam. Asiatic Herpetological Research 7: 19–22.
- Das, I. 2004. Lizards of Borneo. Natural History Publications (Borneo). Kota Kinabalu.
- Das I. 2006. A photographic guide to the snakes and other reptiles of Borneo. London.
- Das I. 2007. Amphibians and reptiles of Brunei. Kota Kinabalu.
- Das, I., & L.L. Grismer. 2003. Two new species of *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Seribuat Archipelago, Pahang and Johor States, West Malaysia. Herpetologica 59: 544–552.
- Das, I., & L.J. Lim. 2000. A new species of *Cyrtodactylus* (Sauria: Gekkonidae) from Pulau Tioman, Malaysia. The Raffles Bulletin of Zoology. 48: 223–231.
- Das, I., & Y. Norsham. 2003. A new species of *Dibamus* (Squamata: Dibamidae) from Peninsular Malaysia. Raffles Bulletin of Zoology 51: 137–141.
- Das, I., & Y. Norsham. 2007. Status of knowledge of the Malaysian herpetofauna. Pp. 31–81 in L. Chua (ed.). Status of Biological Diversity in Malaysia and Threat Assessment of Plant Species in Malaysia. Forest Research Institute Malaysia, Kepong.
- Das, I., Norsham, Y., & B.L. Lim. 2004. A new species of *Calluella Stoliczka*, 1872 (Anura: Microhylidae) from Taman Negara, Pahang State, Peninsular Malaysia. Raffles Bulletin of Zoology. 52: 257–260.
- David, P., Vogel, G., & O.S.G. Pauwels. 2008a. A new species of the genus *Oligodon* Fitzinger, 1826 (Squamata: Colubridae) from southern Vietnam and Cambodia. Zootaxa 1939: 19–37.
- David, P., Vogel, G., & J. van Rooijen. 2008b. A revision of the *Oligodon taeniatus* (Günther, 1861) group (Squamata: Colubridae), with the description of three new species from the Indochinese Region. Zootaxa 1965: 1–49.
- de Bruyn, M., Nugroho, E., Md. M. Hossain, Wilson, J.C., & P.B. Mather. 2005. Phylogeographic evidence for the existence of an ancient biogeographic barrier: the Isthmus of Kra Seaway. Heredity 94: 370–378.
- Denzler, W., & U. Manthey. 1991. A nominal checklist of the lizards inhabiting Peninsular Malaysia and Singapore. Raffles Bulletin of Zoology 39: 309–322.
- Deuve, J. 1970. Serpentes du Laos. Mémoires OSTROM, Paris.
- Diaz, R.E., T.–M. Leong, Grismer, L.L., & Norsham, S.Y. 2004. A new species of *Dibamus* (Squamata: Dibamidae) from West Malaysia. Asiatic Herpetological Research 10: 1–4.
- Diong, C.H., & S.S.L. Lim. 1998. Taxonomic review and morphological description of *Bronchocela cristatella* (Kuhl, 1820) (Squamata: Agamidae) with notes on other species in the genus. Raffles Bulletin of Zoology 46: 345–359.
- Dring, J.C.M. 1979. Amphibians and reptiles from northern Trengganau, Malaysia, with descriptions of two new geckos: *Cnemaspis* and *Cyrtodactylus*. Bulletin of the British Museum (Natural History) 34: 181–241.
- Escobar, R.A. III, Castro, J., Morgan, D., Hover, S.M., Szutz, T.R., McCloskey, K., & R. Gregory. 2003a. Additions to the herpetofauna of Pulau Aur, Johor, West Malaysia. Hamadryad 27: 287–288.
- Escobar, R.A. III, Grismer, J.L., Youmans, T.M., Wood, P.L., Kendall, S.D., Castro, J., Magi, T., Rasmussen, C., Szutz, T.R., Hover, S.M., Morgan, D., Raynor, C., McCloskey, K., Izvernari, N., Hunter, A., Bernard, J.M., Hinojosa, N., Dyer, T., Anlauf, J., Martinez, J., Andreiko, S., Gregory, R., Yeen, L.S., Wuertz, W., Kaiser, H., & L.L. Grismer. 2003b. First report on the herpetofauna of Pulau Tinggi, Johor, West Malaysia. Hamadryad 27: 259–267.
- Evans B.J., Brown, R.M. McGuire, J.A. Supriatna J., Andayani N., Diesmos, A. Iskandar D., Melnick, D.J., & D.C. Cannatella. 2003. Phylogenetics of fanged frogs: testing biogeographical hypotheses at the interface of the Asian and Australian faunal zones. Systematic Biology 52: 794–819.
- Flower, S.S. 1896. Notes on a second collection of batrachians made in the Malay Peninsula 1895–96, with a list of the species recorded from that region. Proceedings of the Zoological Society of London 1896: 856–914.
- Flower, S.S. 1899. Notes on a second collection of reptiles made in the Malay Peninsula and Siam. Proceedings of the Zoological Society of London 1899: 600–696, 885–916.
- Grandison, A.G.C. 1972. The Gunong Benom Expedition 1967. 5. Reptiles and amphibians of Gunong Benom with a description of a new species of *Macrocalamus*. Bulletin of the British Museum of Natural History (Zoology). 23: 45–101.
- Grismer, J.L., & L.L. Grismer. 2010. Who's your mommy? Identifying maternal lineages and a new species of asexual *Leiolepis* Cuvier, 1829 from Southern Vietnam. Zootaxa 2433: 47–61.
- Grismer, J.L., Grismer, L.L., Das, I., Norsham, Y., Lim, B.L., T.–M. Leong, Youmans, T.M., & H. Kaiser. 2004. Species diversity and checklist of the herpetofauna of Pulau Tioman, Peninsular Malaysia with a preliminary overview of habitat utilization. Asiatic Herpetological Research 10: 244–276.

- Grismer, J.L., Leong, T.-M., & S.Y. Norsham. 2003. Two new Sundaland skinks of the genus *Larutia* and their phylogenetic relationships. *Herpetologica* 59: 554–566.
- Grismer, L.L. 2005. A new species of Bent-Toed Gecko (*Cyrtodactylus* Gray 1827) from Pulau Aur, Johor, West Malaysia. *Journal of Herpetology* 39: 424–432.
- Grismer, L.L. 2006a. Amphibians and Reptiles of the Tioman Archipelago, Malaysia. Forestry Department of Peninsular Malaysia, Kuala Lumpur. 215 p.
- Grismer, L.L. 2006b. Two new species of skinks (Genus *Sphenomorphus* Fitzinger 1843) from the Seribuat Archipelago, West Malaysia. *Herpetological Natural History* 9: 151–162.
- Grismer, L.L. 2006c. A new species of *Ansonia* Stoliczka 1870 (Anura: Bufonidae) from a lowland rainforest in southern peninsular Malaysia. *Herpetologica* 62: 466–475.
- Grismer, L.L. 2007a. A new species of small montane forest floor skink (Genus *Sphenomorphus* Fitzinger 1843) from southern peninsular Malaysia. *Herpetologica* 63: 544–551.
- Grismer, L.L. 2007b. A new species of *Ingerophrynus* (Anura: Bufonidae) from a lowland rain forest in southern Peninsular Malaysia. *Journal of Herpetology* 41: 225–230.
- Grismer, L.L. 2008a. On the distribution and identification of *Cyrtodactylus brevipalmatus* Smith 1923 and *Cyrtodactylus elok* Dring 1979. *Raffles Bulletin of Zoology* 56: 177–179.
- Grismer, L.L. 2008b. A new species of insular skink (Genus *Sphenomorphus* Fitzinger 1843) from the Langkawi Archipelago, Kedah, West Malaysia with the first report of the herpetofauna of Pulau Singa Besar and an updated checklist of the herpetofauna of Pulau Langkawi. *Zootaxa* 1691: 53–56.
- Grismer, L.L. 2008c. A revised and updated checklist of lizards of Peninsular Malaysia. *Zootaxa* 1860: 28–34.
- Grismer, L.L. 2011a. Field Guide to the Amphibians and Reptiles of the Seribuat Archipelago, Peninsular Malaysia. Frankfurt am Main.
- Grismer, L.L. 2011b. Lizards of Peninsular Malaysia, Singapore and Their Adjacent Archipelagos. Frankfurt am Main.
- Grismer, L.L., & K.O. Chan. 2008. A new species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Pulau Perhentian Besar, Terengganu, Peninsular Malaysia. *Zootaxa* 1771: 1–15.
- Grismer, L.L., & K.O. Chan. 2009. A new species of karst dwelling *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Sarawak, Borneo. *Zootaxa* 2246: 21–31.
- Grismer, L.L., & K.O. Chan. 2010. Another new Rock Gecko (genus *Cnemaspis* Strauch 1887) from Pulau Langkawi, Kedah, Peninsular Malaysia. *Zootaxa* 2419: 51–62.
- Grismer, L.L., K.O. Chan, Grismer, J.L., Wood, P.L. Jr., & D. Belabut. 2008c. Three new species of *Cyrtodactylus* (Squamata: Gekkonidae) from Peninsular Malaysia. *Zootaxa*. 1921:1–23.
- Grismer, L.L., K.O. Chan, Grismer, J.L., Wood, Jr., P.L., & A. Norhayati. 2010b. A checklist of the herpetofauna of the Banjaran Bintang, Peninsular Malaysia. *Russian Journal of Herpetology* 17: 147–160.
- Grismer, L.L., Chav T., Neang, T., Wood, Jr. P.L., Grismer, J.L., Youmans, T.M., Ponce, A., Daltry, J.C., & H. Kaiser. 2007a. The herpetofauna of the Phnom Aural Wildlife Sanctuary and checklist of the herpetofauna of the Cardamom Mountains, Cambodia. *Hamadryad* 31: 216–241.
- Grismer, L.L., & I. Das. 2006. A new species of gekkonid lizard of the genus *Cnemaspis* Strauch 1887 from Pulau Pemanggil, Johor, West Malaysia. *Herpetological Natural History* 10: 1–7.
- Grismer, L.L., Das, I., & T.-M. Leong. 2003. A new species of *Gongylosoma* (Squamata: Colubridae) from Pulau Tioman. *Herpetologica* 59: 567–574.
- Grismer, L.L., Grismer, J.L., & J.A. McGuire. 2006c. A new species of pitviper of the genus *Popeia* (Squamata: Viperidae) from Pulau Tioman, Pahang, West Malaysia. *Zootaxa* 1305: 1–19.
- Grismer, L.L., Grismer, J.L., Wood, Jr., P.L., & K.O. Chan. 2008a. The distribution, taxonomy, and redescription of the geckos *Cnemaspis affinis* (Stoliczka 1887) and *C. flavolineata* (Nicholls 1949) with descriptions of a new montane species and two new lowland, karst-dwelling species from Peninsular Malaysia. *Zootaxa* 1931: 1–24.
- Grismer, L.L., Grismer, J.L., & T.M. Youmans. 2004a. A new species of *Leptolalax* (Anura: Megophryidae) from Pulau Tioman, West Malaysia. *Asiatic Herpetological Research* 10: 8–11.
- Grismer, L.L., Kaiser, H., & S.Y. Norsham. 2004b. A new species of reed snake of the genus *Calamaria* H. Boie, 1827 from Pulau Tioman, Pahang, West Malaysia. *Hamadryad* 28: 1–6.
- Grismer, L. L., & T.M. Leong. 2005. New species of *Cyrtodactylus* (Squamata: Gekkonidae) from Southern Peninsular Malaysia. *Journal of Herpetology* 39: 64–71.
- Grismer, L.L., Neang, T., Chav, T., & J. Grismer. 2008b. Checklist of the amphibians and reptiles of the Cardamom region of southwestern Cambodia. *Cambodian Journal of natural History* 1: 12–28.
- Grismer, L.L., Neang, T., Chav, T., Wood, P.L., Jr., Oaks, J.R., Holden, J., Grismer, J.L., Szutz, T.R., & T.M. Youmans. 2008d. Additional amphibians and reptiles from the Phnom Samkos Wildlife Sanctuary in the northwestern Cardamom Mountains, Cambodia, with comments on their taxonomy and the discovery of three new species. *Raffles Bulletin of Zoology* 56: 161–175.
- Grismer, L.L., Neang, T., Thou, C., & J. Holden. 2007b. A new species of *Chiromantis* Peters 1854 (Anura: Rhacophoridae) from Phnom Samkos in the northwest-

- ern Cardamom Mountains, Cambodia. *Herpetologica* 63: 392–400.
- Grismer, L.L., & V.T. Ngo. 2007. Four new species of the gekkonid genus *Cnemaspis* Strauch 1887 (Reptilia: Squamata) from southern Vietnam. *Herpetologica* 63: 482–500.
- Grismer, L.L., Ngo, V.T., & J.L. Grismer. 2008e. A new species of pitviper of the genus *Cryptelytrops* (Squamata: Viperidae) from southern Vietnam. *Zootaxa* 1715: 57–68.
- Grismer, L.L., Ngo, V.T., & J.L. Grismer. 2010a. A colorful new species of insular rock gecko (*Cnemaspis* Strauch 1887) from southern Vietnam. *Zootaxa* 2352: 46–58.
- Grismer, L.L., & A. Norhayati. 2008. A new insular species of *Cyrtodactylus* (Squamata: Gekkonidae) from the Langkawi Archipelago, Kedah, Peninsular Malaysia. *Zootaxa* 1924: 53–68.
- Grismer, L.L., Norhayati, A., & K.O. Chan. 2009a. A new, diminutive, upland *Sphenomorphus* Fitzinger 1843 (Squamata: Scincidae) from the Belum-Temengor Forest Complex, Peninsular Malaysia. *Zootaxa* 2312: 27–38.
- Grismer, L.L., Norhayati, A., K.O. Chan, Belabut, D. Muin, M.A., Wood, Jr., P.W., & J.L. Grismer. 2009b. Two new diminutive species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Peninsular Malaysia. *Zootaxa* 2019: 40–56.
- Grismer, L.L., Norsham, S.Y., B.L. Lim, T.-M. Leong, Das, I., Sosa, R.A., Grismer, J.L., Crane, K.M., Diaz, R.E., Figueroa, S.V., Grismer, L.L., Ledbetter, C.A., Newbold, S.C., Newbold, S.R., Patel, C.P., Castro, J., Escobar III, R.A., Guerrero, S., Pinedo, J.W., Trujillo J., & H. Kaiser. 2001a. First report on the herpetofauna of Pulau Aur, Johor, West Malaysia. *Hamadryad* 26: 322–325.
- Grismer, L.L., Norsham, S.Y., B.L. Lim, T.-M. Leong, Das, I., Sosa, R.A., Grismer, J.L., Crane, K.M., Diaz, R.E., Figueroa, S.V., Grismer, L.L., Ledbetter, C.A., Newbold, S.C., Newbold, S.R., Patel, C.P., Castro, J., Escobar III, R.A., Guerrero, S., Pinedo, J.W., Trujillo J., & H. Kaiser. 2001b. Report of the herpetofauna of Pulau Tulai, West Malaysia. *Hamadryad* 26: 341–342.
- Grismer, L.L., & K.A. Pan. 2008. Diversity, endemism, and conservation of the amphibians and reptiles of southern Peninsular Malaysia and its offshore islands. *Herpetological Review* 3: 270–281.
- Grismer, L.L., Sukumaran, J., Grismer, J.L., Youmans, T.M., Wood, Jr., P.L., & R. Johnson. 2006b. Report on the Herpetofauna of the Temengor Forest Reserve, Perak, West Malaysia. *Hamadryad* 29: 15–32.
- Grismer, L.L., Sumontha, M., Cota, M., Grismer, J.L., Wood, Jr., P.L., Pauwels, O.S.G., & K. Kunya. 2010c. A revision and redescription of the rock gecko *Cnemaspis siamensis* (Taylor 1925) from Peninsular Thailand with descriptions of seven new species. *Zootaxa* 2576: 1–55.
- Grismer, L.L., Youmans, T.M., Wood, Jr., P.L., & J.L. Grismer. 2006a. Checklist of the herpetofauna of the Seribu Archipelago, West Malaysia with comments on biogeography, natural history and adaptive types. *Raffles Bulletin of Zoology* 54:157–180.
- Grismer, L.L., Youmans, T.M., Wood, Jr., P.L., Ponce, A., Wright, S.B., Jones, B.S., Johnson, R., Sanders, K.L., Gower, D.J. Norsham, S.Y., & K.K.P. Lim. 2006d. Checklist on the herpetofauna of Pulau Langkawi, Malaysia, with comments on taxonomy. *Hamadryad* 30: 61–74.
- Grismer, L.L., Wood, Jr., P.L., & J.L. Grismer. 2009c. A new insular skink of the genus *Sphenomorphus* Strauch 1887 (Squamata: Scincidae) from Pulau Perhentian Besar, Terengganu, Peninsular Malaysia. *Tropical Life Sciences Research* 20:51–69.
- Grismer, L.L., Wood, Jr., P.L., & T.M. Youmans. 2007c. Redescription of *Cyrtodactylus sworderi* (Smith 1925) from Southern Peninsular Malaysia. *Hamadryad* 31: 250–257.
- Hall, R. 1998. The plate tectonics of Cenozoic SE Asia and the distribution of land and sea. Pp. 99–131 in Hall, R., & J.D. Holloway (eds.). *Biogeography and Geological Evolution of Southeast Asia*. Leiden.
- Hall, R. 2001. Cenozoic reconstructions of SE Asia and the SW Pacific: changing patterns of land and sea. Pp. 35–56 in I. Metcalfe, J.M.B. Smith, M. Morwood, & I. Davidson (eds.). *Faunal and Floral Migrations and Evolution in SE Asia-Australasia*. Lisse.
- Hall, R. 2002. Cenozoic geological and plate tectonic evolution of SE Asia and the SW Pacific: computer-based reconstructions and animations. *Journal of Asian Earth Sciences* 20: 353–434.
- Hallermann, J., & J.A. McGuire. 2001. A new species of *Pseudocalotes* (Squamata: Agamidae) from Bukit Larut, West Malaysia. *Herpetologica* 57: 255–265.
- Hien, P., Grossmann, W., & C. Schäfer. 2001. Beitrag zur Kenntnis der landbewohnenden Reptilienfauna von Pulau Tioman, West-Malaysia. *Sauria* 23: 11–28.
- Huges, J.B., Round, P.D., & D.S. Woodruff. 2003. The Indochinese-Sundaic faunal transition at the Isthmus of Kra: an analysis of resident forest bird species distributions. *Journal of Biogeography* 30: 569–580.
- Inger, R.F., Orlov, N., & I. Darevsky. 1999. Frogs of Vietnam: a report on new collections. *Fieldiana: Zoology* (New series) 92: 1–46.
- Inger, R.F., & E.L. Tan. 1996. *The Natural History of Amphibians and Reptiles in Sabah*. Natural History Publications (Borneo). Kota Kinabalu. 101 pp.
- Inger, R.F., & H.K. Voris. 2001. The biogeographical relations of the frogs and snakes of Sundaland. *Journal of Biogeography* 28: 863–891.
- Inger, R.F., & R.B. Stuebing. 2005. *A Field Guide to the Frogs of Borneo*. Kota Kinabalu.

- Karns, D.R., O'Bannon, A., Voris, H.K., & L.A. Weigt. 2000. Biogeographical implications of mitochondrial DNA variation in the Bockadam snake (*Cerberus rynchops*, Serpentes: Homalopsinae) in Southeast Asia. *Journal of Biogeography* 27: 391–402.
- Kloss, C.B. 1915. On two snakes new to the fauna of the Malay Peninsula. *Journal of the Federated Malay States Museum* 6: 41–42.
- Kloss, C.B. 1921. Some water snakes new to, or rare in the Malay Peninsula. *Journal of the Federated Malay States Museum* 10: 201–202.
- Kottelat, M. 1990. New species and populations of cave nemacheilines in South and South-east Asia (Osteichthyes: Balitoridae). *Memiors Biospéologie* 17: 49–55.
- Laidlaw, F.F. 1900. On the frogs collected during the "Skeat Expedition" to the Malay Peninsula, 1899–1900. *Proceedings of the Zoological Society of London* 1900: 883–890.
- Laidlaw, F.F. 1901a. On a collection of snakes, crocodiles, and chelonians from the Malay Peninsula, made by members of the "Skeat Expedition," 1899–1900. *Proceedings of the Zoological Society of London* 1901: 575–586.
- Laidlaw, F.F. 1901b. On a collection of lizards from the Malay Peninsula, made by members of the "Skeat Expedition," 1899–1900. *Proceedings of the Zoological Society of London* 1901: 301–311.
- Leong, T.-M., Grismer, L.L., & Mumpuni. 2003. Preliminary checklists of the Anambas and Natuna Islands (South China Sea). *Hamadryad* 27: 165–174.
- Leong, T.-M., & L.L. Grismer. 2004. A new species of Kukri Snake, *Oligodon* (Colubridae) from Pulau Tioman, West Malaysia. *Asiatic Herpetological Research* 10: 12–16.
- Leong, T.-M., & B.L. Lim. 2003. A new species of *Rana* (Amphibia: Anura: Ranidae) from the highlands of the Malay Peninsula, with diagnostic larval descriptions. *Raffles Bulletin of Zoology* 51: 115–122.
- Lim, L.J. 1998. The taxonomy of West Malaysian and Singapore Scincidae (Reptilia: Sauria). Unpublished M.Sc. Thesis, National University of Singapore, Kent Ridge, Singapore.
- Lim, B.L., & I. Das. 1999. *Turtles of Borneo and Peninsular Malaysia*. Natural History Publications (Borneo) Sdn Bhd., Kota Kinabalu.
- Lim, K.K.P., T.M. Leong, & B.L. Lim. 2002. Herpetofaunal records from Cameron Highlands, peninsular Malaysia. *Journal of Wildlife and Parks* 20: 49–57.
- Lim, K.K.P., & L.J. Lim. 1999. The terrestrial herpetofauna of Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology Supplement Number* 6: 131–156.
- Long, B., Swan, S.R., Tith, B., & R. Ay. 2002. Rapid conservation assessment of the large mammals, birds, reptiles and amphibians of the Veal Veng wetland. Pp.34–37 in: J. C. Daltry (ed.). *Social and Ecological Surveys of the Veal Veng Wetland, Cardamom Mountains, Cambodia, with Special Reference to the Conservation of the Siamese Crocodile*. Cambodia Programme, Fauna & Flora International, Phnom Penh.
- Malhotra, A. R.S. Thorpe, & B.L. Stuart. 2011. Two new species of pitviper of the genus *Cryptelytropis* Cope 1860 (Squamata: Viperidae: Crotelinae) from South Asia. *Zootaxa* 2757: 1–23.
- Malkmus, R. Manthey, U., Vogel, G., Hoffmann, P., & J. Kosuch. 2002. *Amphibians & Reptiles of Mount Kinabalu (North Borneo)*. Herwald.
- Manthey, U., & W. Grossmann. 1997. *Amphibien & Reptilien Südostasiens*. Münster.
- Matsui, M., Belabut, D.M. Norhayati, A., & Y. Hoi-Sen. 2009. A new species of *Leptolalax* (Amphibia, Anura, Megophryidae) from Peninsular Malaysia. *Zoological Science* 26: 243–247.
- Matsui, M., Chan-ard, T., & J. Nabhitabhata. 1996. Distinct specific status of *Kalophrynus pleurostigma interlineatus* (Anura, Microhylidae). *Copeia* 1996: 440–445.
- Matsui, M., & J. Ibrahim. 2006. A new Cascade Frog of the subgenus *Odorrana* from Peninsular Malaysia. *Zoological Science* 64: 647–651.
- Nishikawa 2010a. Systematic reassessments of fanged frogs from China and adjacent regions (Anura: Dicroglossidae). *Zootaxa* 2345: 33–42.
- Matsui, M., Nishikawa, K., Khonsue, W., Panha, S., & J. Nabhitabhata. 2001. Allozymic variation in *Rana nigrovittata* (Amphibia: Anura) within Thailand with special reference to the taxonomic status of *R. mortenseni*. *The Natural History Journal of Chulalongkorn University* 1: 15–22.
- Matsui, M., Ito, H., Shimada, T., Ota, H., Saidapur, S. K., Khonsue, W., Tanaka-Ueno, T., & W. Guan-Fu. 2005a. Taxonomic relationships within the Pan-Oriental narrow-mouth toad *Microhyla ornata* as revealed by mtDNA analysis (Amphibia, Anura, Microhylidae). *Zoological Science* 22: 489–495.
- Matsui, M., Shimada, T., Ota, H., & T-U Tomoko. 2005b. Multiple invasions of the Ryukyu Archipelago by Oriental frogs of the subgenus *Odorrana* with phylogenetic reassessment of the related subgenera of the genus *Rana*. *Molecular Phylogenetics and Evolution* 37: 733–742.
- Matsui, M., Tominaga, A., Liu, W., Khonsue, W., Grismer, L.L., Diesmos, A.C., Das, I., Sudin, A., Yambun, P., Yong, H., Sukumaran, J., & R. Brown. 2010b. Phylogenetic relationships of *Ansonia* from Southeast Asia inferred from mitochondrial DNA sequences: systematic and biogeographic implications (Anura: Bufonidae). *Molecular Phylogenetics and Evolution* 54: 561–570.
- McLeod, D.S., & A. Norhayati. 2007. A new species of *Theloderma* (Anura: Rhacophoridae) from southern

- Thailand and peninsular Malaysia. *Russian Journal of Herpetology* 14: 65–72.
- Moler, P., Babb, R., Abercrombie, A.B., Hope, C., Dao, V.H., Lane, L., Chillag, Z., Le, M.D., Dang, M.L., Ly, T., & V.K. Nguyen. 2008. Amphibians and Reptiles of Phu Quoc. A herpetological survey from May 22, 2008–June 7, 2008. *Wildlife at Risk Report*.
- Muster, G.J.M. 1983. Taxonomy of the genus *Draco* L. (Agamidae, Lacertilia, Reptilia). *Zoologische Verhandlungen* 199: 1–120.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., & J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 420–423.
- Norsham, Y., & Lim, B.L. 2002. A new species of mountain reed snake, *Macrocalamus gentingensis*, from Genting Highlands, Pahang, peninsular Malaysia. *Hamadryad* 27: 83–89.
- Neang, T., & J. Holden. 2008. A Field Guide to the Amphibians of Cambodia. *Fauna & Flora International – Cambodia Programme*. Phnom Penh.
- Ng, H.H., Tan, H.H., & K.K.P. Lim. 1999. The inland fishes of Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology Supplement* Number 6: 169–188.
- Ngo, V.T. 2008. Two new cave-dwelling species of *Cyrtodactylus* Gray (Squamata: Gekkonidae) from southwestern Vietnam. *Zootaxa* 1909: 37–51.
- Ngo, V.T., Grismer, L.L., & J.L. Grismer. 2010. A new species of *Cyrtodactylus* Gray, 1827 (Squamata: Gekkonidae) in Phu Quoc National Park, Kien Giang Biosphere Reserve, southwestern Vietnam. *Zootaxa* 2604: 37–51.
- Ngo, V.T., Grismer, L.L., & J.L. Grismer. 2008. A new endemic cave dwelling species of *Cyrtodactylus* Gray, 1827 (Squamata: Gekkonidae) in Kien Giang Biosphere Reserve, southwestern Vietnam. *Zootaxa* 1967: 53–62.
- Nguyen, V.S., Ho, T.C., & Q.T. Nguyen. 2009. Herpetofauna of Vietnam. Frankfurt am Main.
- Nguyen, V.L., Ta, T.K.O., & M. Tateishi. 2000. Late Holocene depositional environments and coastal evolution of the Mekong River Delta, southern Vietnam. *Journal of Asian Earth Science* 18: 427–439.
- Norsham, Y., & B.L. Lim. 2002. A new species of mountain reed snake, *Macrocalamus gentingensis*, from Genting Highlands, Pahang, peninsular Malaysia. *Hamadryad* 27: 83–89.
- Ota, H., Hikida, T., Nabhitabhata, J., & S. Panha. 2001. Cryptic taxonomic diversity in two broadly distributed lizards of Thailand (*Mabuya macularia* and *Dixonius siamensis*) as revealed by chromosomal investigations (Reptilia: Lacertilia). *The Natural History Journal of Chulalongkorn University* 1: 1–7.
- Ouboter, P.E. 1986. A revision of the genus *Scincella* (Reptilia: Sauria: Scincidae) of Asia, with some notes on its evolution. *Zoologische Verhandlungen* 229: 1–65.
- Outlaw, D.C., & G. Voelker. 2008. Pliocene climatic change in insular Southeast Asia as an engine of diversification in *Ficedula* flycatchers. *Journal of Biogeography* 35: 739–752.
- Pauwels, O.S.G., David, P., Chimsunchart, C., & K. Thirakhupt. 2003. Reptiles of Phetchaburi Province, western Thailand: a list of species, with natural history notes, and a discussion on the biogeography at the Isthmus of Kra. *Natural History Journal of Chulalongkorn University* 3: 23–53.
- Reddy, S. 2008. Systematics and biogeography of the shrike-babblers (*Pteruthius*): species limits, molecular phylogenetics, and diversification patterns across southern Asia. *Molecular Phylogenetics and Evolution* 47: 54–72.
- Saint Girons, H. 1972. Les serpents du Cambodge. *Mémoires du Muséum National d'Histoire Naturelle, Paris, Nouvelle série, A, Zoologie*. 74: 1–170.
- Sanders, K.L., Malhotra, A., Gumprecht, A., Thorpe, R.S., & U. Kuch. 2004. *Popeia inornata*, a new species of pitviper from west Malaysia (Squamata: Viperidae: Crotalinae). *Russian Journal of Herpetology* 11: 163–176.
- Sathiamurthy, E., & H.K. Voris. 2006. Maps of Holocene sea level transgression and submerged lakes on the Sunda Shelf. *The Natural History Journal of Chulalongkorn University, Supplement* 2: 1–43.
- Sly, G.R. 1976. New locality records for some peninsular Amphibia, Reptilia, and Mammalia. *The Malayan Nature Journal* 29: 155–157.
- Smedley, N. 1928. Some reptiles and amphibian from the Anamba Islands. *Journal of the Malayan British Royal Asiatic Society* 6: 76–77.
- Smedley, N. 1931a. On some reptiles and a frog from the Natuna Islands. *Bulletin of the Raffles Museum* 5: 46–48.
- Smedley, H. 1931b. Amphians and reptiles from the south Natuna Islands. *Bulletin of the Raffles Museum* 6: 102–104.
- Smedley, N. 1931c. Amphibians and reptiles from the Cameron Highlands, Malay Peninsula. *Bulletin of the Raffles Museum* 6: 105–123.
- Smith, M.A. 1922a. On a collection of reptiles and batrachians from the mountains of Pahang, Malay Peninsula. *Journal of the Federated Malay States Museum* 10: 263–282.
- Smith, M.A. 1922b. Notes on reptiles and batrachians from Siam and Indo-China. *Journal of the Natural History Society of Siam* 4: 203–225.
- Smith, M.A. 1925. A new ground-gecko (*Gymnodactylus*) from the Malay Peninsula. *Journal of the Malaysian British Royal Asiatic Society* 3: 87.
- Smith, M.A. 1930. The Reptilia and Amphibia of the Malay Peninsula from the Isthmus of Kra to Singapore including the adjacent islands. *Bulletin of the Raffles*

- Museum 3: 1–149.
- Smith, M.A. 1935. On a collection of reptiles and amphibians from Perak, Malay Peninsula. Bulletin of the Raffles Museum 10: 61–63.
- Sodhi, N.S., Yong, H.S. & P.K.L. Ng 1999 (eds.). The Biodiversity of Pulau Tioman, Peninsular Malaysia. Raffles Bulletin of Zoology Supplement Number 6 288 pp.
- Sterling, E.J., Hurley, M.M., & D.M. Le. 2006. A Natural History of Vietnam. New Haven.
- Stuart, B.L. 2005. New frog records from Laos. Herpetological Review 36: 473–479.
- Stuart, B.L., & D.A. Emmet. 2006. A collection of amphibians and reptiles from the Elephant and Cardamom Mountains, southwestern Cambodia. Fieldiana Zoology (New series) 109: 1–27.
- Stuart, B.L., Sok, K., & T. Neang. 2006. A collection of amphibians and reptiles from hilly eastern Cambodia. Raffles Bulletin of Zoology 54: 129–155.
- Stuebing, R.B., & R.F. Inger. 1999. A Field Guide to the Snakes of Borneo. Kota Kinabalu.
- Swan, R.S., & J.C. Daltry. 2002. Reptiles and amphibians. Pp. 23–40 in J.C. Daltry (ed.). Social and Ecological Surveys of Phnom Aural Wildlife Sanctuary, Cardamom Mountains, Cambodia. Cambodia Programme, Fauna & Flora International, and the Ministry of Environment, Phnom Penh.
- Ta, T.K.O., Nguyen, V.L., Masaaki, T., Iwao, K., Susumu, T., & S. Yoshiki. 2002. Holocene delta evolution and sediment discharge of the Mekong River, southern Vietnam. Quaternary Science Reviews 21: 1807–1819.
- Tamblyn A.N., Turner, C., O'Mally, R., Weaver, N., Hughes, T., Hardingham, S., & H. Roberts. 2005. Malaysia Tropical Forest Conservation Project Report of the Perhentian Phase 2005. Coral Cay Conservation Ltd. London.
- Tan, B.C., & H. Mohamed. 1999. A preliminary checklist of mosses of Pulau Tioman, Peninsular Malaysia. Raffles Bulletin of Zoology Supplement Number 6: 73–76.
- Taylor, E.H. 1962. The amphibian fauna of Thailand. University of Science Kansas Bulletin 43: 265–599.
- Taylor, E.H. 1963. The lizards of Thailand. University of Science Kansas Bulletin 44: 687–1077.
- Taylor, E. H. 1965. The serpents of Thailand and adjacent waters. University of Science Kansas Bulletin 45: 609–1096.
- Teynie, A., David, P., Ohler, A., & K. Lauanglath. 2004. Notes on a collection of amphibians and reptiles from southern Laos, with a discussion of the occurrence of Indo-Malayan species. Hamadryad 29: 33–62.
- Tweedie, M.W.F. 1983. The Snakes of Malaya. Singapore.
- Vogel, G., P. David, & O.S.G. Pauwels. 2004. A review of morphological variation in *Trimeresurus popeiorum* (Serpentes: Viperidae: Crotalinae) with the description of two new species. Zootaxa 727: 1–63.
- Vogel, G., & J. van Rooijen. 2007. A new species of *Dendrelaphis* (Serpentes: Colubridae) from Southeast Asia. Zootaxa 1394: 25–45.
- Vogel, G., & J. van Rooijen. 2008. Contributions to a review of the *Dendrelaphis pictus* (Gmelin, 1789) complex - 2. the eastern forms. Herpetozoa 21 (1/2): 3–29.
- Voris, H.K. 2000. Maps of Pleistocene sea levels in Southeast Asia: shorelines, river systems, time durations. Journal of Biogeography 27: 1153–1167.
- Webb, C.O. 2005. Vegetation mapping in Phnom Samkos and Phnom Aural Wildlife Sanctuaries, Cardamom Mountains, Cambodia. Unpubl. Report to Fauna & Flora International, Phnom Penh.
- Wood, P.L., Jr., Grismer, L.L., Youmans, T.M., Nurolhuda B.N., Norhayati, A., & J. Senawi. 2008b. Additions to the herpetofauna of Endau-Rompin, Johor, West Malaysia. Herpetological Review 39: 112–121.
- Wood, P.L., Jr., Grismer, L.L., Norhayati, A., & J. Senawi. 2008a. Two new species of torrent dwelling toads *Ansonia stoliczka* 1872 (Anura: Bufonidae) from Peninsular Malaysia. Herpetologica 64: 321–40.
- Wood, P.L. Jr., Grismer, L. L., Grismer, J. L., Neang, T., Thou, C., & J. Holden. (2010): A new cryptic species of *Acanthosaura* Gray, 1831 (Squamata: Agamidae) from Thailand and Cambodia. Zootaxa 2488: 22–38.
- Wood, P.L., Jr., Grismer, J.L., Grismer, L.L. Norhayati, A., Chan, K.O., & A.M. Bauer. 2009. Two new montane species of *Acanthosaura* Gray, 1831 (Squamata: Agamidae) from Peninsular Malaysia. Zootaxa 2012: 28–46.
- Wood, P. L., Kaiser, H., Looper, S., Youmans, T.M., Grismer, J.L., & L.L. Grismer. 2004a. A first report on the herpetofauna of Pulau Besar, Johor, West Malaysia. Hamadryad 28: 106–109.
- Wood, P.L., Szutz, T.R., Grismer, J.L., Youmans, T.M., & L.L. Grismer. 2003a. First report on the herpetofauna of Pulau Sembilang and Pulau Seribuat, Pahang, West Malaysia. Hamadryad 27: 281–284.
- Wood, P.L., Youmans, T.M., Raynor, C., Bernard, J.M., Hinojosa, N., Dyer, T., Andreiko, S., van Dijk, P.P., Wuertz, W. & L.S. Yeen 2003b. First report on the herpetofauna of Pulau Dayang, Johor, West Malaysia. Hamadryad 27: 284–285.
- Wood, P.L., Youmans, T.M., Grismer, J.L., Wheatly, J., Wright, S., Valdivia, C., Ponce, A., Escobar, R., Amin, S., Baker, P., Bernard, J., Looper, S., Marsh, N., Martin, L., Padilla, N., Rosser, R., Srivastava, A., Srivastava, V., Wright, S. Yeen, L.S., Kaiser, H., & L.L. Grismer. 2004b. First report on the herpetofauna of Pulau Sibul, Johor, West Malaysia. Hamadryad 28: 116–119.
- Woodruff, D.S. 2003. Neogene marine transgressions, paleogeography, and the biogeographic transitions on the Thai-Malay Peninsula. Journal of Biogeography 30: 551–567.

- Wüster, W., Thorpe, R.S., Cox, M.J., Jintakune, P., & J. Nabhitabhata. 1995. Population systematics of the snake genus *Naja* (Reptilia: Serpentes: Elapidae) in Indochina: multivariate morphometrics and comparative mitochondrial DNA sequencing (cytochrome oxidase I). *Journal of Evolutionary Biology* 8: 493–510.
- Yeo, D.C.J., Cai, Y., & P.K.L. Ng. 1999. The freshwater and terrestrial decopod crustacea of Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology Supplement Number 6*: 197–244.
- Yeo, D.C.J., & P.K.L. Ng. 1999. A new species of *Geosesarma* (Crustacea: Decapoda: Brachyura: Grapsidae) from Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology Supplement Number 6*: 189–196.
- Youmans, T.M., & L.L. Grismer. 2006. Description of a new species of *Cyrtodactylus* (Reptilia: Squamata: Gekkonidae) from the Seribuat Archipelago, West Malaysia. *Herpetological natural History* 39: 584–591.
- Youmans, T.M., Grismer, J.L., Escobar III, R.A., Johnson, R., & L.L. Grismer. 2002. First report on the herpetofauna of Pulau Pemanggil, Johor, West Malaysia. *Hamadryad* 27: 148–149.
- Ziegler, T. 2002. Die Amphibien und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam. Berlin.